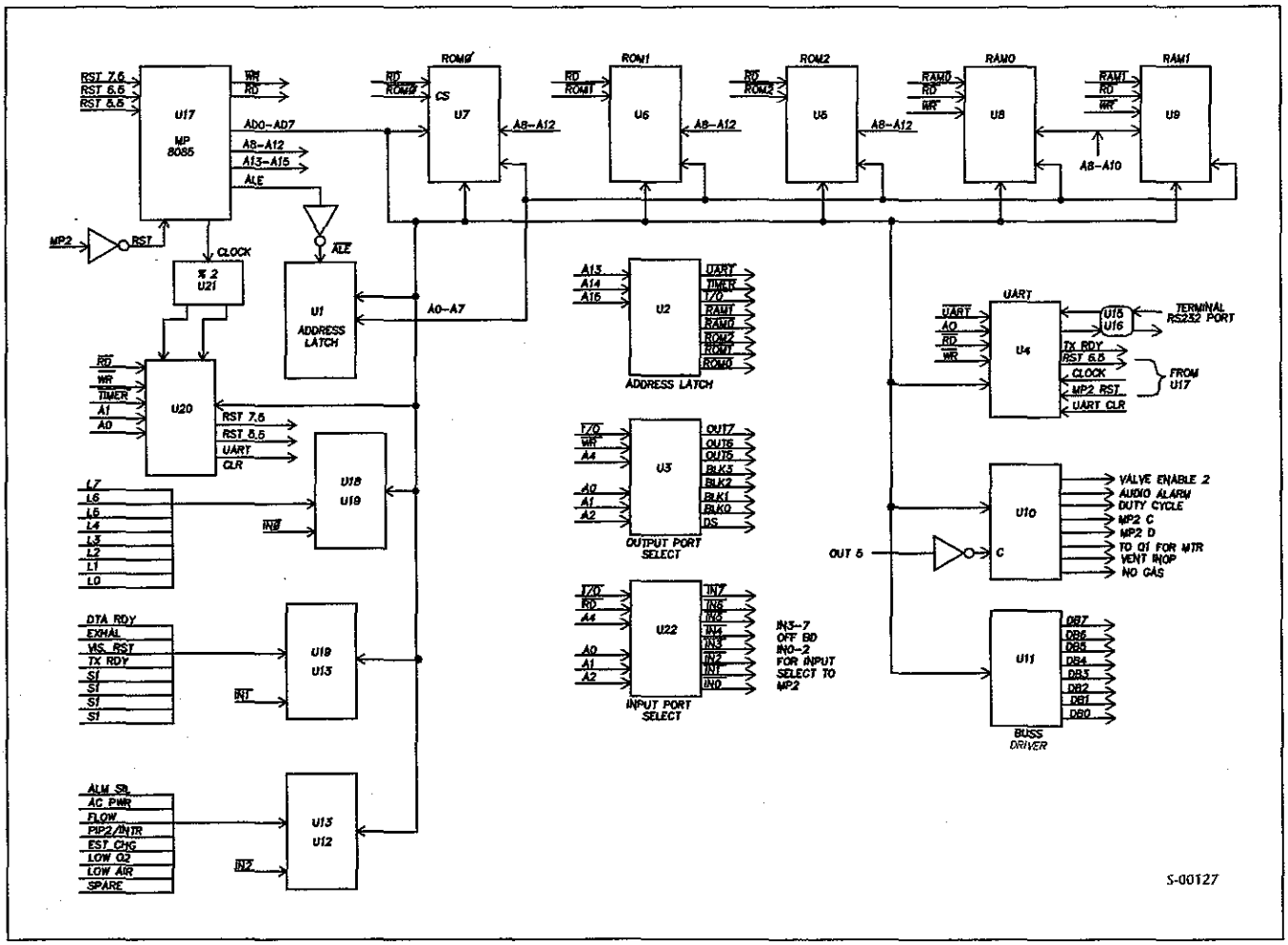

Figure 7-6. MP2 PCA Block Diagram

7.1.5 MP101 PCA

The MP101 PCA (P/N – N-1101345) uses a 80631 microprocessor and its associated buss structure to perform program control of the operation of the Infant *Star* 500/950 ventilators in basically the same manner as the MP2 PCA.

A function of the MP101 programming is to control the operation of the Analog PCA and the decoding of the digital information obtained from it.

The programming of this PCA also provides for input and output port timing signals that are used on the I/O PCA for Front Panel Mode Selection/Display Information and output direction control of information and control signals.

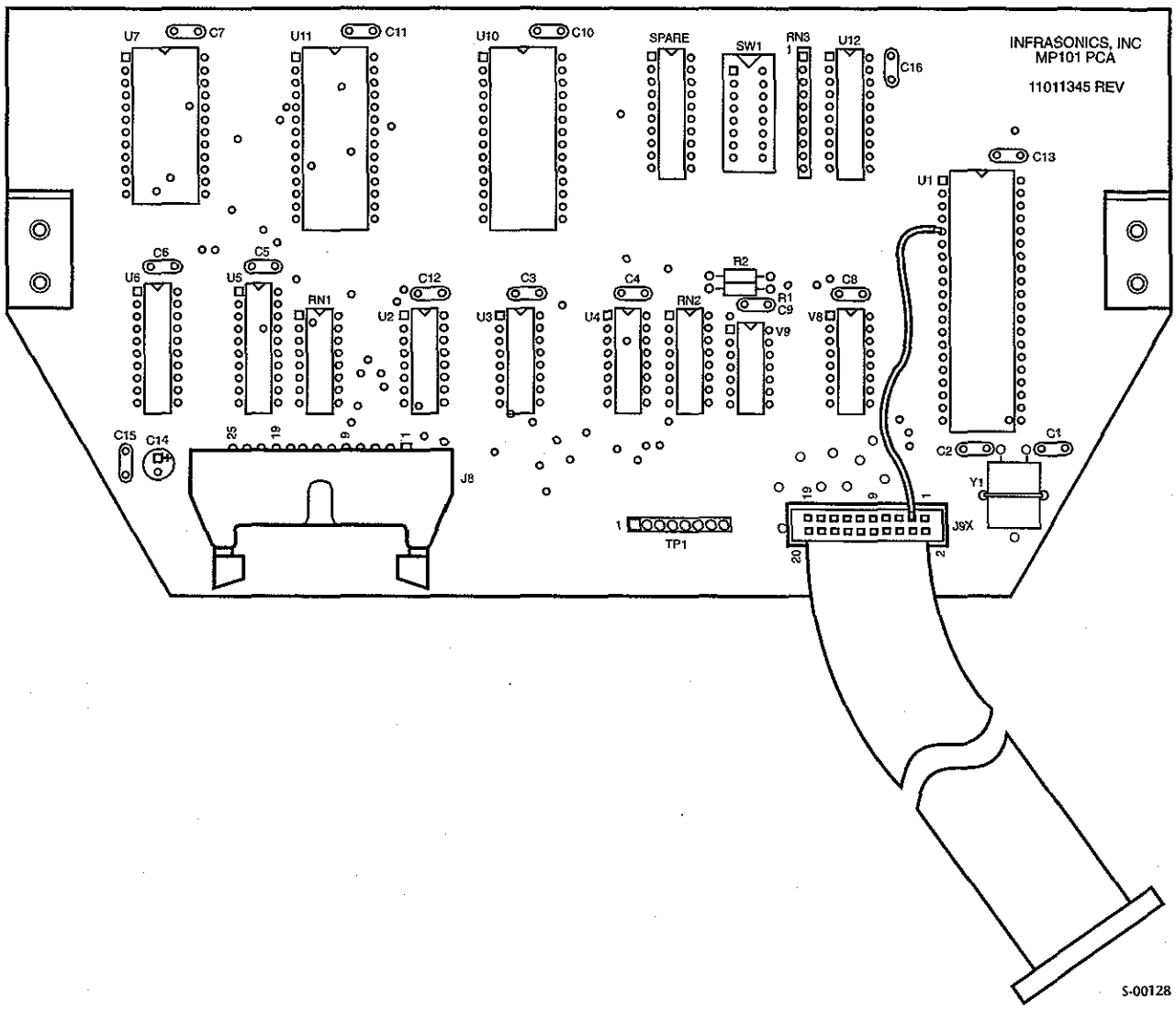

Figure 7-7. MP101 PCA

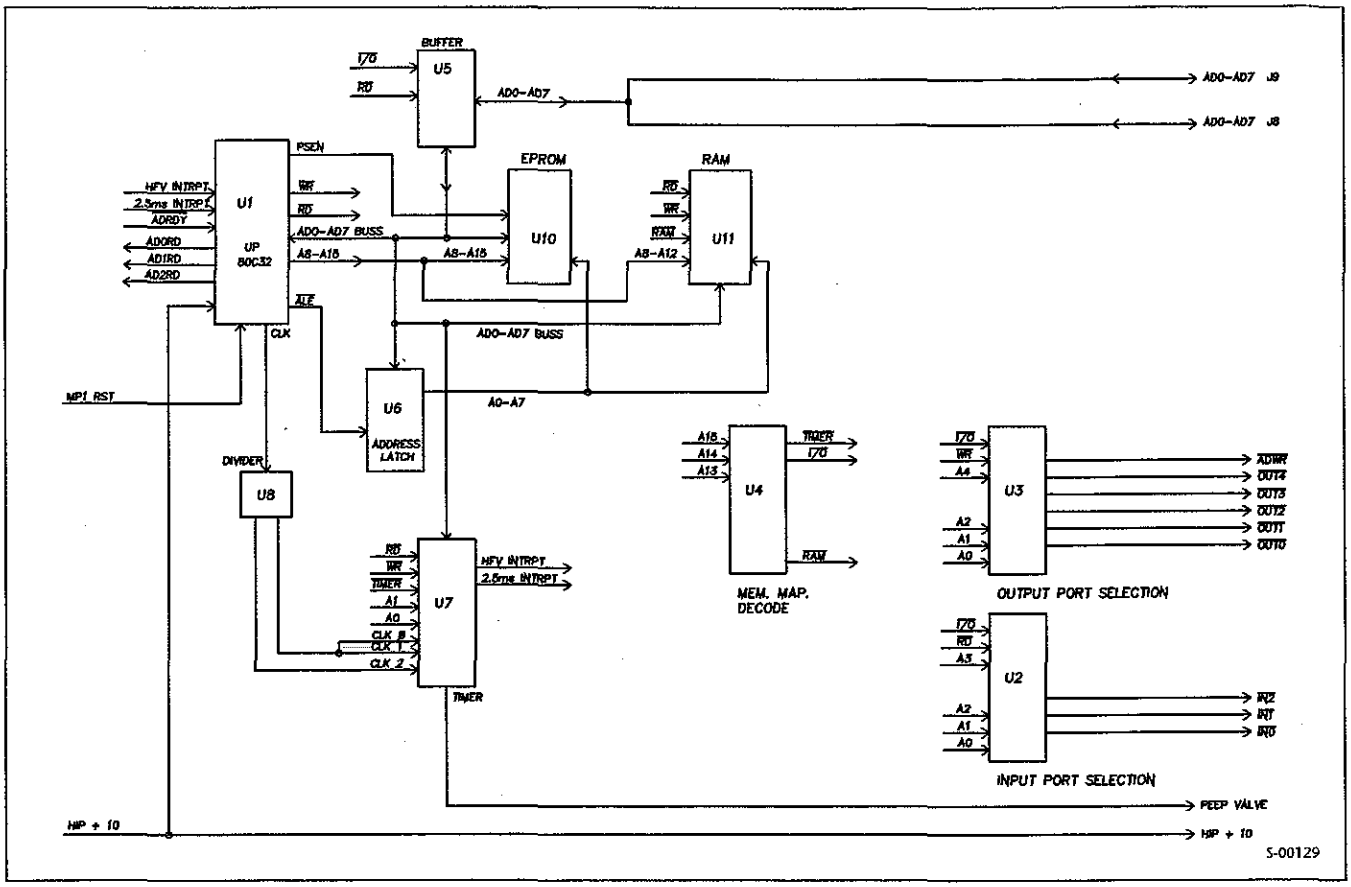

Figure 7-8. MP101 Block Diagram

7.1.6 Pressure Transducer PCA

The Pressure Transducer PCA (P/N – N-1101163) is located in the pneumatic base assembly and provides the following outputs:

- PT2
- Prox + and Prox -
- PT1

The PT2 signal takes the proximal pressure reading of 0 - 100 cmH_2O and converts it to output voltage 0 - 2.344 Vdc, which is directly proportional to the input pressure. This is accomplished by the use of a constant I source and a metering circuit (U4 and U2) that feeds the PT2 output amp to accomplish the signal conversion. The output of the PT2 gain amp is paralleled to the prox amp which converts the 0 - 100 cmH_2O proximal pressure to a proportional 0 - 1 Vdc output used for oscilloscope viewing of the breathing pulses.

The PT1 signal takes the 0 - 100 cmH_2O To Patient pressure and converts this signal to -0.298 Vdc to +2.126 Vdc in the same scenario as PT2.

Caution

To prevent water damage to the Pressure Transducer PCA, an in-line filter (P/N - N-4403017) can be added to the proximal pressure line.

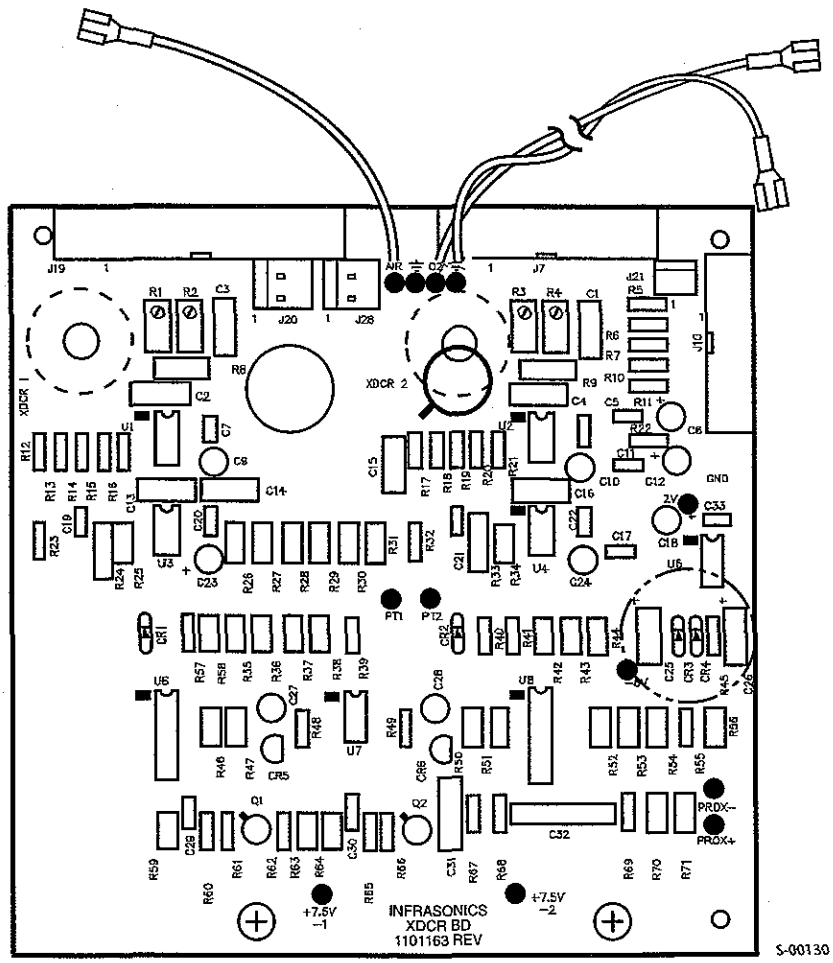

Figure 7-9. Pressure Transducer PCA

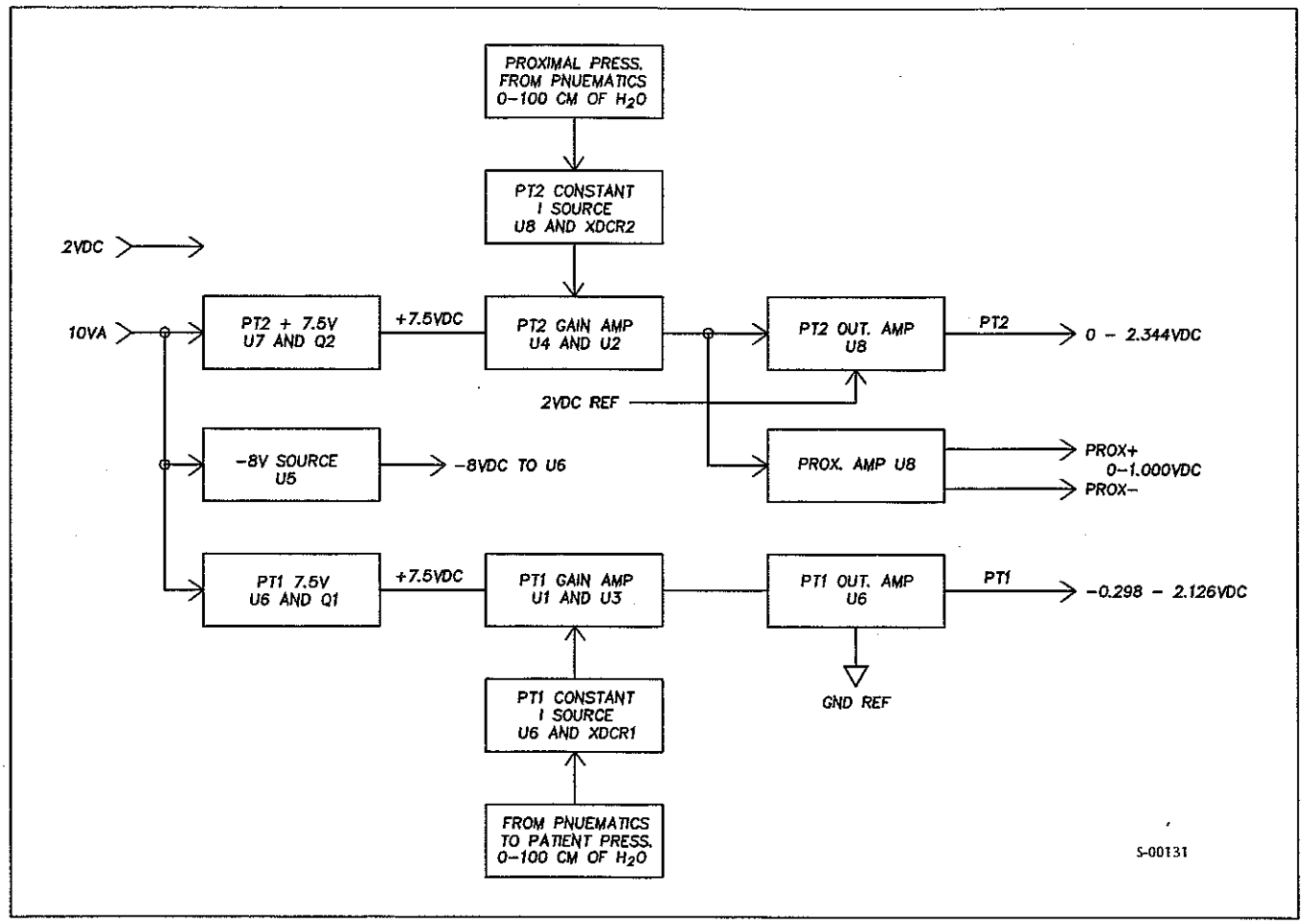

Figure 7-10. Pressure Transducer PCA Block Diagram

7.1.7 Front Panel PCA

The Front Panel PCA (P/N – N-1150012) assembly is divided into three sections:

- front panel controls
- mode and display select
- strobe decode and driver (includes display LEDs)

The front panel controls consist of eight separate potentiometers connected to the +5 VA supply. The output of each are:

- Ventilator Rate 0 - 5 V
- Peak Insp. Time 0 - 5 V
- Inspiratory Time 0 - 5 V
- PEEP/CPAP 0 - 5 V
- Flow Rate 0 - 5 V
- Background Flow 0 - 5 V
- High Insp. Pressure 0 - 5 V
- Low Insp. Pressure 0 - 5 V

These analog signals are routed to the analog PCA for conversion to digital numbers.

The Mode Select and Display consists of five individual switches that route the +5 Vdc to the MP2 and I/O PCAs. These settings are decoded and determine how the Infant *Star* 500/950 ventilators are being used.

The strobe decode takes the DB0 - DB7 buss from the MP2 PCA and decodes them into strobes 0 - 7 at the high-going edge of the DS signal to U6 and U7. The DB0 - DB7 buss is then multiplexed to block data latches 0 - 4 to provide seven segment drivers to the LEDs associated with each of the four respective blocks. When a strobe is active to a specific LED within a block that has segments decoded, these segments of the LED light cause the LED to provide the appropriate front panel indications, as required by the internal program of the Infant *Star* 500/950 ventilators. The strobe decode also routes the following signals across the PCA:

- Meter + to E1
- Meter - to E2
- Intlk 1 to Intlk 2

It also provides display information for Power Loss, Ext. Power Loss, and Vent Inop.

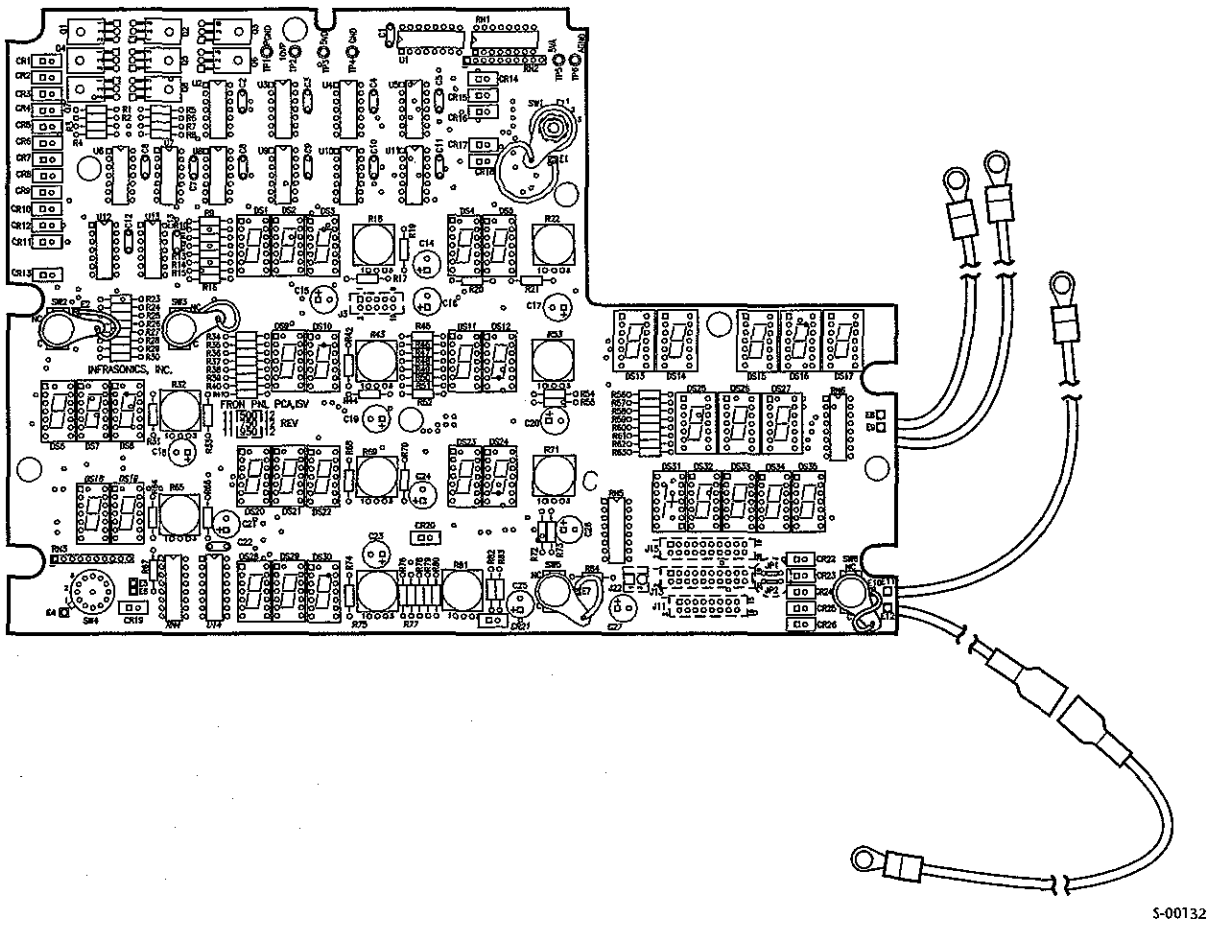

Figure 7-11. Front Panel PCA

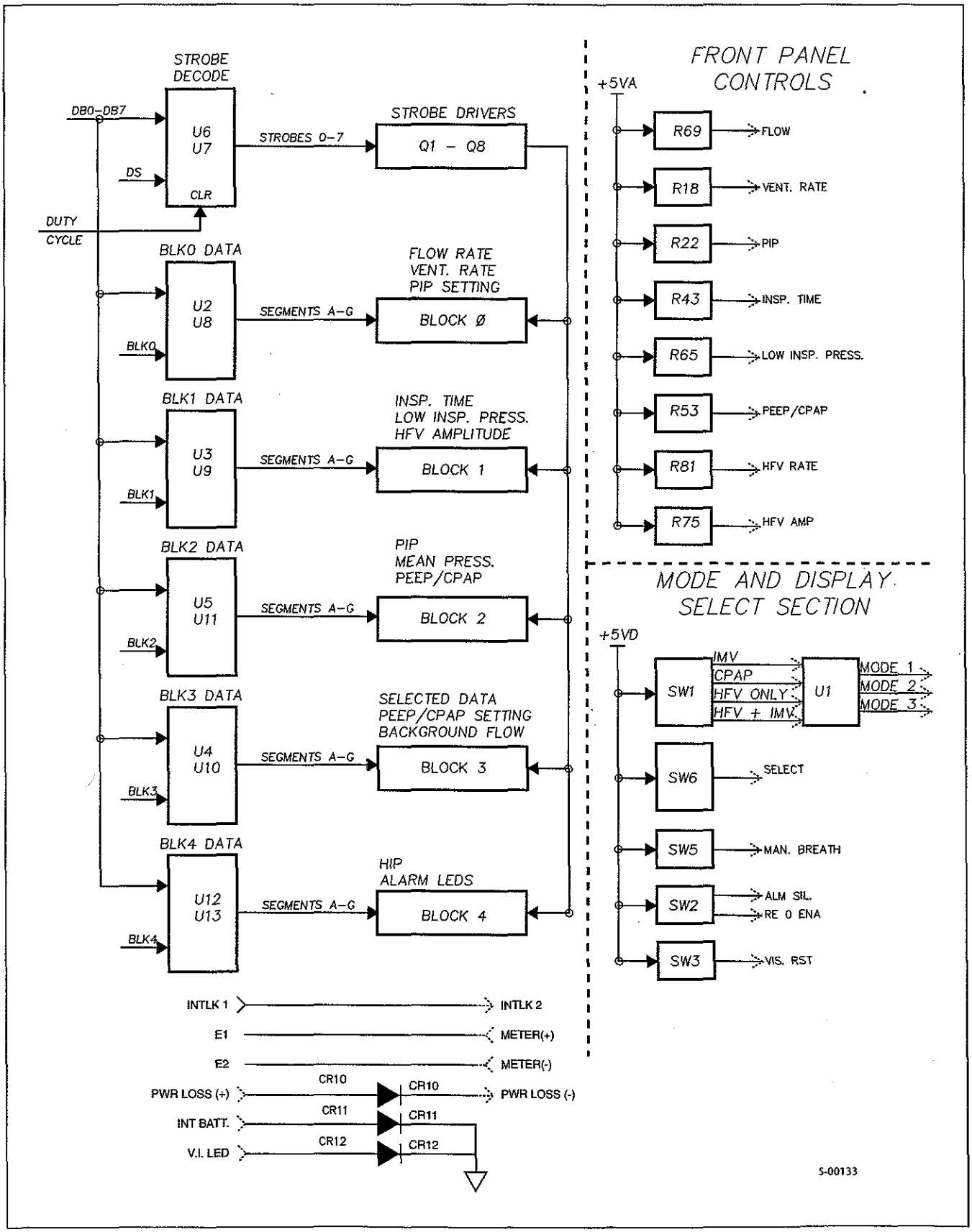

Figure 7-12. Front Panel Block Diagram

7.1.8 I/O (Input/Output) PCA

The I/O PCA (P/N – N-1101157) serves three functions:

- input/output buss routing
- watchdog timer circuits for MP101 and MP2 PCAs
- interlock routing of seven separate signals

The functions of the input/output are to gate information into and from AD0 - AD7 buss as follows:

- In 0 enables Vent Mode, Vent Type, Manual Breath and MP2 Hand Shake information from Front Panel to AD0 - AD7 buss.
- In 1 enables Display Select and Re-Zero information to AD0 - AD7 buss.
- In 2 enables *Star* Sync Trigger to the AD0 - AD7 buss from the front panel.
- Out 0 transfers information from the buss to the MP2 PCA through L0 - L7 (information from the A/D buss).
- Out 1 passes information from the MP101 PCA via the AD0 - AD7 buss to the Alarm Driver PCA controlling valve enabling lines (out of U7).
- Out 2 controls AD0 - AD7 information out of U12.
- Out 3 controls information out of U6 from the AD0 - AD7 buss which is used for valve control information and for gating of the MP101 watchdog timer. The watchdog timer circuits serve to provide resets to the appropriate memory PCAs when these circuits sense the loss of activity from either of these PCAs.

Interlock routing is provided for the following signals:

- Vent Inop LED
- Power Loss LED +
- Power Loss LED -
- Int. Batt LED
- Interlock 1
- PIP Interlock
- PEEP Value Interlock

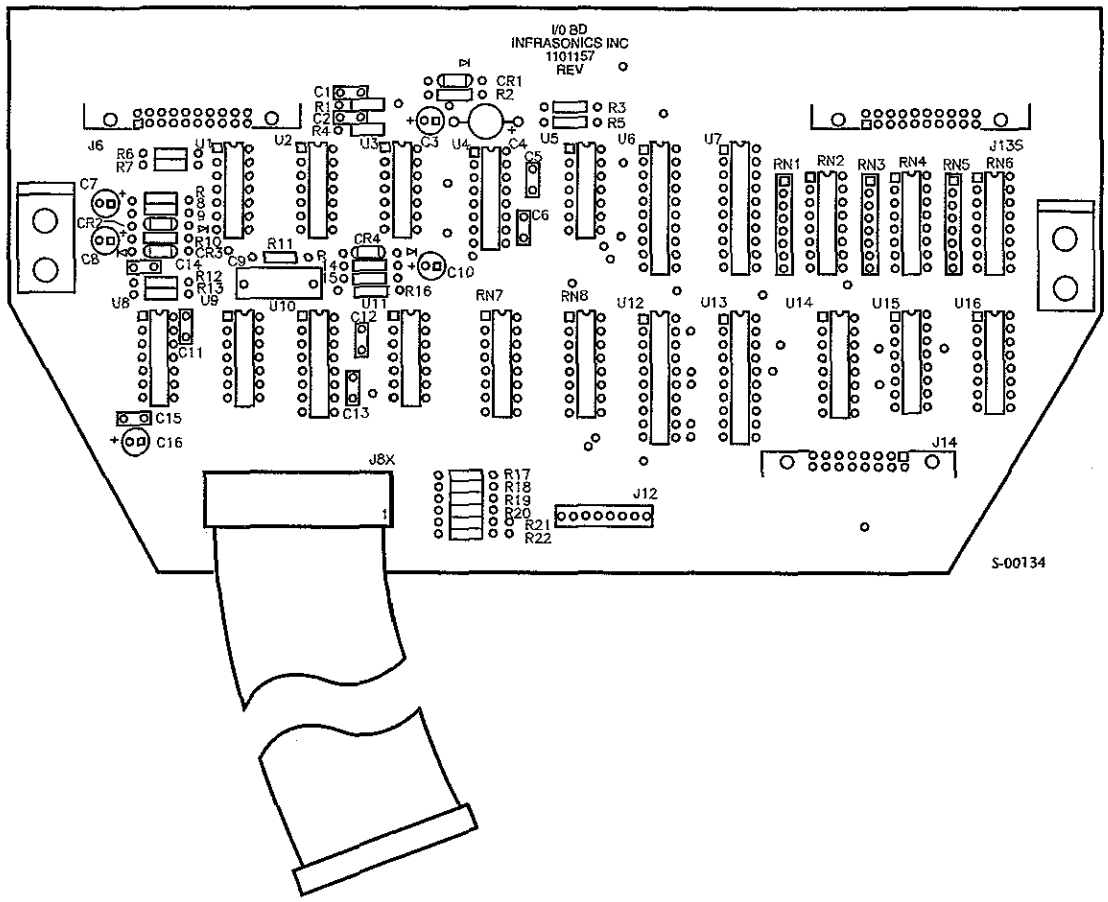

Figure 7-13. I/O (Input/Output) PCA

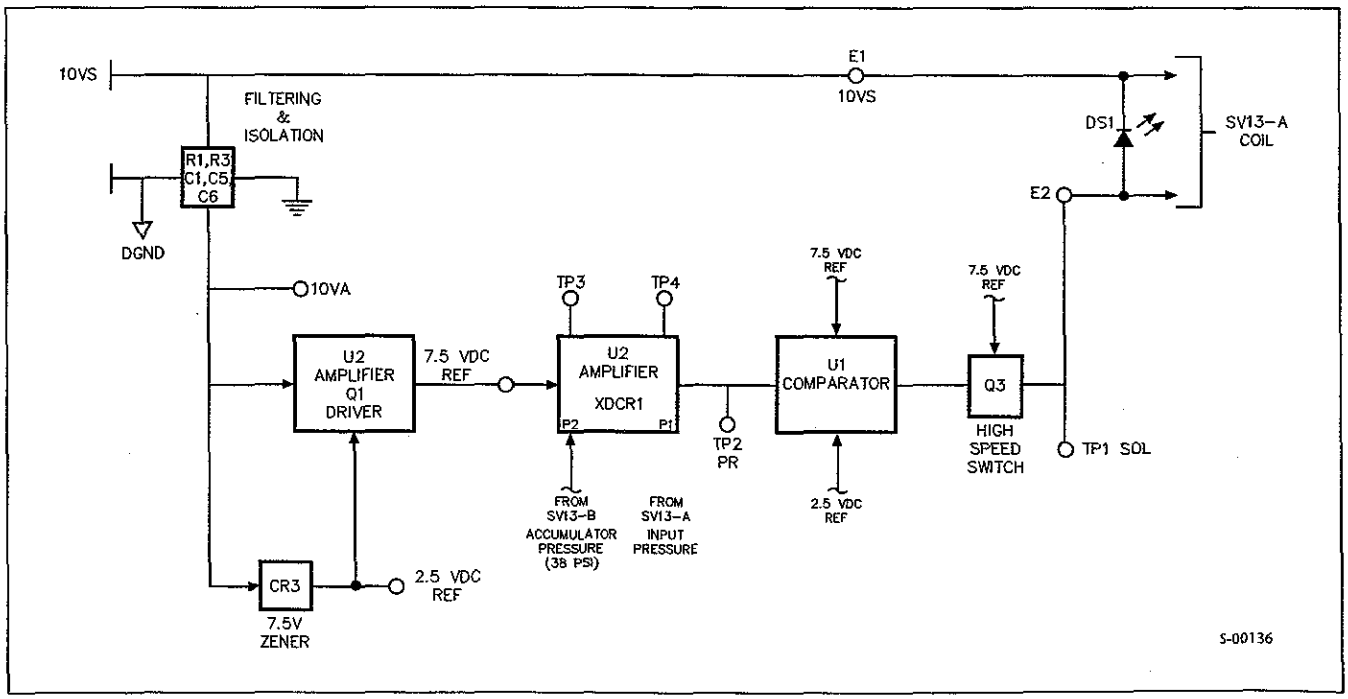

Figure 7-14. I/O (Input/Output) PCA Block Diagram

7.1.9 Alarm Driver PCA (Original)

The Alarm Driver PCA (P/N – N-1101162) is divided into three operational sections:

- Alarm Monitor
- Valve Control
- Power Monitoring

The Alarm Monitor checks the status of five control signals and detects whether certain operational conditions exist. When any parameter is in the wrong state, the alarm monitor removes power from the solenoids and provides for Front Panel indication of trouble(s) by causing the Vent Inop LED to light. Once this condition has occurred, the power must be recycled to clear the Vent Inop thus restoring the 10 V SV to the solenoids.

The Valve Enable provides drive to the appropriate solenoids as required by the I/O information (U7 on I/O PCA).

Power Monitoring provides for both visual and audible indications whenever input voltage control changes occur. Visual indications appear on the Front Panel and the audible indication is provided by an internal system of buzzers.

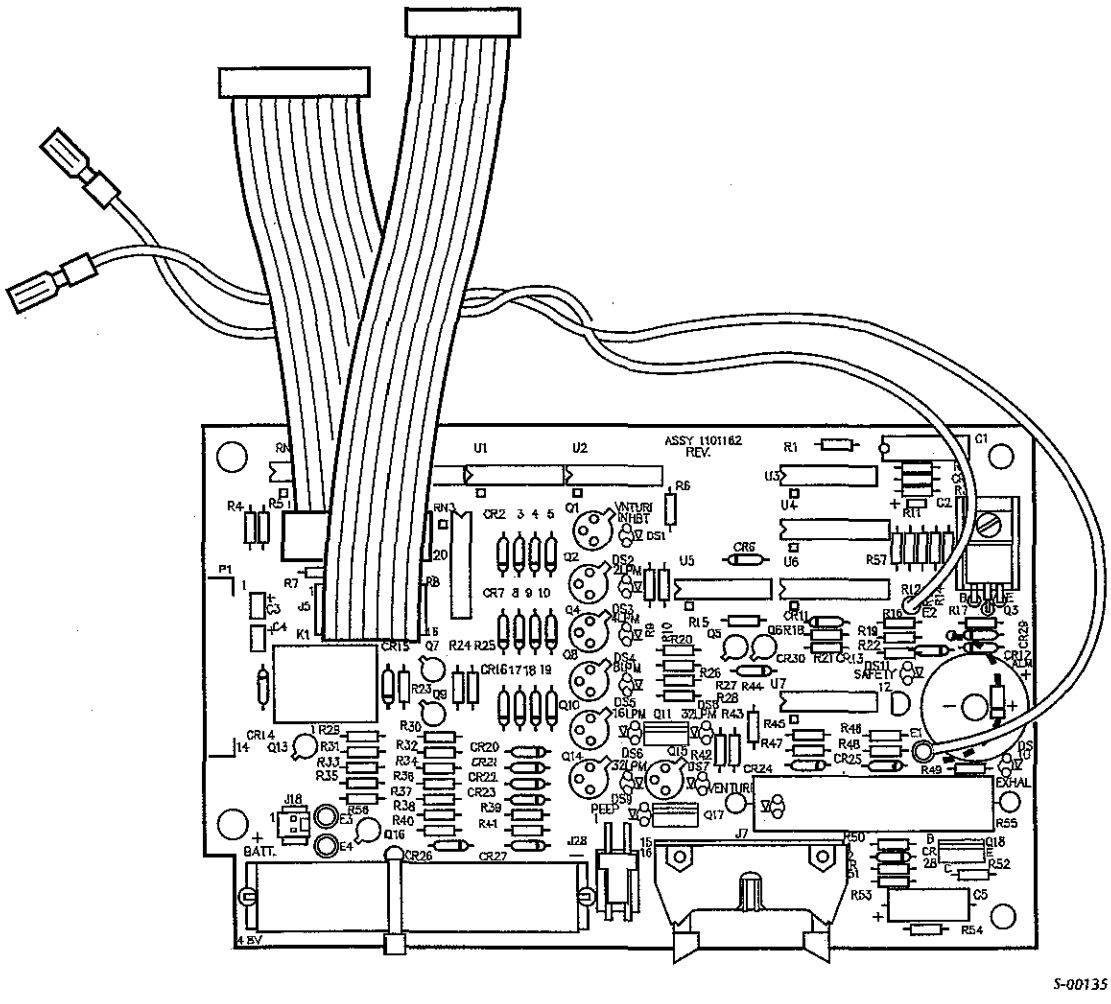

Figure 7-15. Alarm Driver PCA

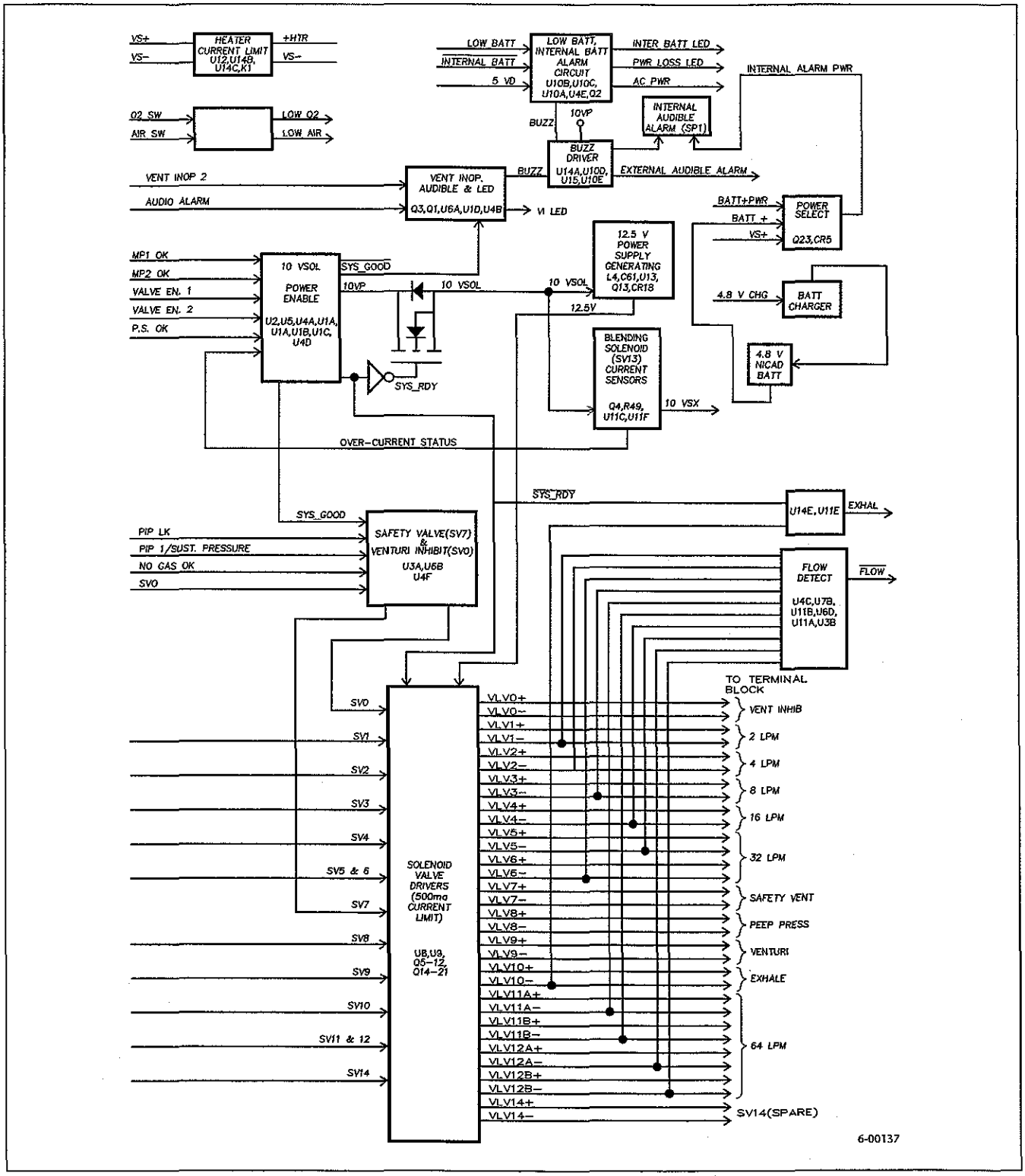

Figure 7-16. Alarm Driver PCA Block Diagram

7.1.10 Differential Pressure PCA

The Differential Pressure PCA (P/N – N-1101186) controls the flow of blended gases from the oxygen blender and keeps the accumulator pressure at 38 psi, including:

- Upstream Pressure
- Downstream Pressure
- Low Flow Oxygen or Air Pressure Alarms
- Low Manifold Pressure Alarm (PS3) 8 psi

When the pressure in the Accumulator drops to approximately 28 psi, SV13 turns off, opening the pilot valve allowing flow and building up the pressure in the Accumulator. When pressure at the Accumulator increases to within 2 psi of R1 (air regulator pressure setting), SV13 energizes, closing the pilot valve.

The Differential Pressure PCA is connected to SV13, PS-3, 10 VS, 10 VA, and the Upstream and Downstream Pressure Tubing.

To measure the Upstream and Downstream pressure controls flow, the pressure is fed to the Differential Pressure PCA where a transducer (XDCR1) converts the pressure to a negative and positive voltage output. The resultant voltages are sent through two stages of amplification. This amplified output is then compared with a known Voltage Reference and is used to gate SV13 on and off. This gating can be observed by watching DS1 on the PCA which illuminates when SV13 energizes.

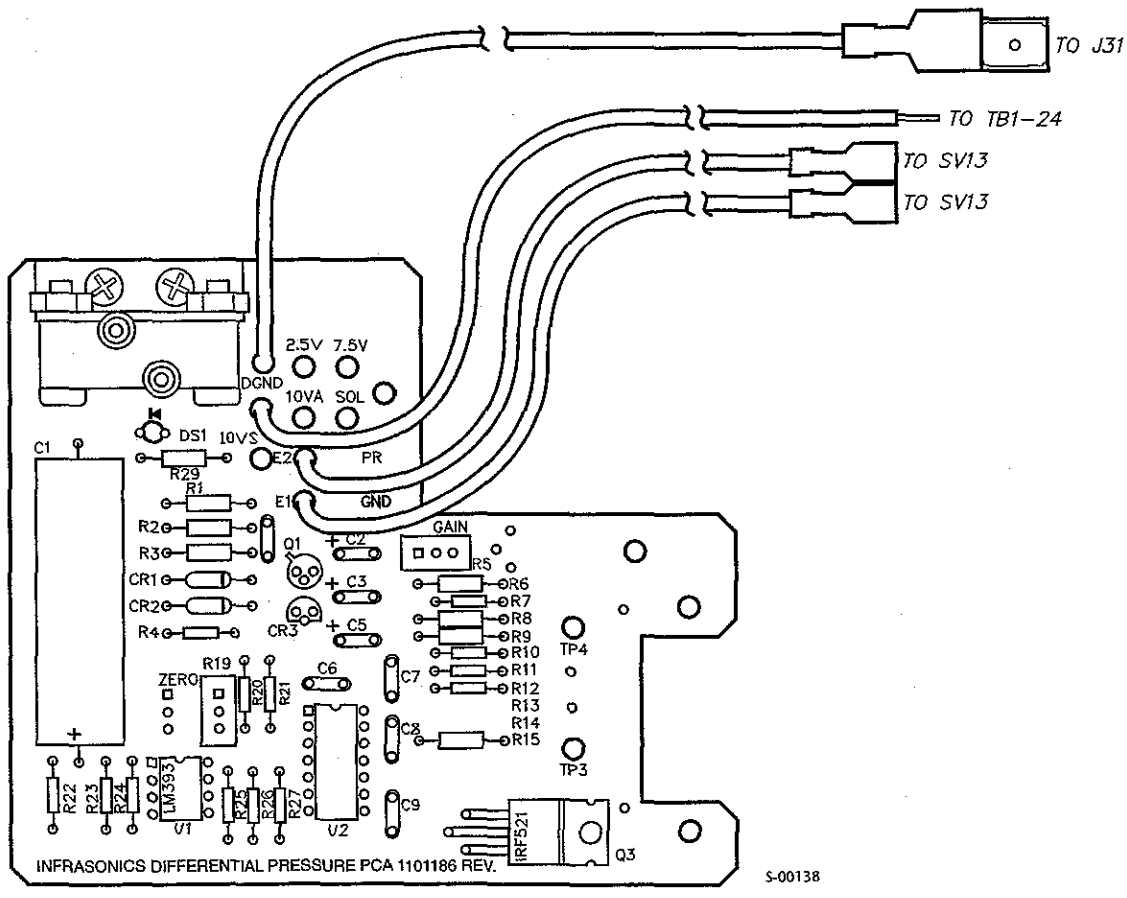

Figure 7-17. Differential Pressure PCA

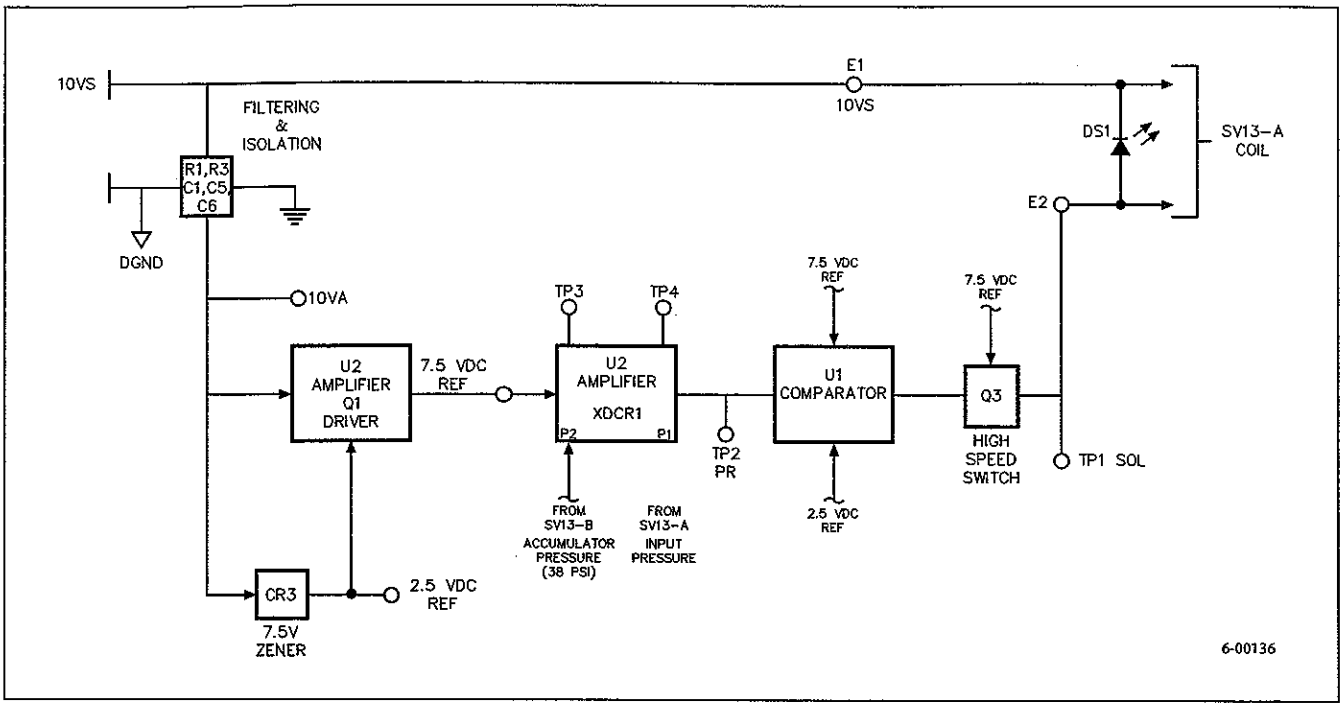

Figure 7-18. Differential Pressure PCA Block Diagram

7.1.11 CE Mark Ventilators

NOTE:

CE marked ventilators can be identified by the CE labels affixed to the rear of the ventilator, the ferrite cores on the RS-232 cable battery, the analog output harnesses, and the capacitor between terminals 1 and 4 of Terminal Block 3 (TB3). Contact your local Mallinckrodt representative if these components are not installed.

7.1.11.1 Power Monitoring

There is a green rocker switch, on the ventilator rear panel, whose function is to charge the ventilator battery. When the ventilator has power and is turned ON, and the green rocker switch is set to the ON (|) position, a light behind the switch illuminates. This indicates the *internal battery is charging.*

The rocker switch is equipped with an ac circuit breaker which protects the ventilator against possible shorts and line surges. When the circuit breaker trips, the rocker switch switches OFF (0 position) thus interrupting ac power to the ventilator. To reset the circuit breaker, set the rocker switch back to the ON position.

If the ventilator has power and is turned ON, but the green rocker switch is turned OFF, the power supplied to the ventilator does not charge the internal battery. When this is the case, the External Power Loss LED, on the front panel display, illuminates. This indicates the ventilator is operating on the internal battery. After approximately 30 minutes of battery operation, the Low Battery light illuminates and an alarm sounds. If the ventilator continues operation without the rocker switch being reset (turned ON), the ventilator will declare a VENTILATOR INOPERATIVE condition after approximately 5 minutes.

7.1.11.2 Alarm Driver PCA - Current Limiting

The Alarm Driver PCA (P/N – N-1175017) is divided into five operational sections (Figure 7-19):

- Alarm Monitor
- 12.5 V Power Supply Generation.
- Valve Control
- Power Monitoring
- Alarm Control

The Alarm Driver PCA checks the following status signals:

- VALVE ENA2
- MP2 OK
- VALVE ENA1
- MP101 OK
- PS OK
- over-current status from the OXYGEN/AIR gases blending SV13

When any of these parameters are in the wrong state, the alarm monitor will negate the SYS_RDY and SYS_GOOD signals. Setting the SYS_RDY signal to a logic low state, stops the 10 V solenoid from supplying power to all solenoids. Setting the SYS_GOOD signal to a logic low state, causes the safety valve (SV7) to open and the VENTURI INHIBIT valve (SV0) to deactivate, thus causing no venturi flow to reach the exhalation block. The Front Panel Vent Inop LED and the External and Internal audible alarms are activated simultaneously. Once

this condition occurs, power must be recycled to clear the Vent Inop alarm and thus restore power to the solenoids.

The 12.5 V power supply generates 12.5 Vdc whenever 10 V solenoid is present. The 12.5 V switching power supply is current limiting at approximately 3A and is precisely adjusting potentiometer R44 (in the voltage monitoring section) to set output voltage.

Valve Driving provides power to the appropriate solenoids as required by the I/O information (U7 on I/O PCA). All valve drivers are current limiting at 500 mA. If any valve exceeds this limit, the driver for that valve will shut off until power is recycled. All flow valves are driven by two stage drivers. At approximately 8 mS after activation, the voltage across the valve is 11 Vdc and then changed to 5.5 Vdc until the valve is deactivated. The PEEP, EXHALATION, VENTURI, and SPARE valves are driven with a constant 11 Vdc.

Power Monitoring monitors the supply of current to the heater mounted on the exhalation block and the 0_2 blender. When the heater current exceeds approximately 0.62 A, the heater relay K1 is latched OFF until power is recycled. When the 0_2 blender current exceeds approximately 0.6A, the SYS_RDY signal is forced to a logic low state thus causing the 10 V solenoid to disconnect from the valves and activate the alarms as described above. It also monitors Power status: *INT BATT and LOW BATT signals from the Power supply and I/O PCA. The corresponding LEDs are activated as a result of these signals.

Alarm Control drives the internal, external, and remote alarms with the same signal (*BUZZ). This signal can be activated by the AUD ALM, VENT INOP2, VALVE ENA2, MP2 OK, VALVE ENA1, MP101 OK, and PS OK signals. The alarms are powered by 10 VP if the ac line voltage is present, or by the internal battery if the ac line voltage is disconnected. When there is a system power loss, the 4.8 V back-up battery provides power to the internal audible alarm. The oscillator with 0.5 seconds on-time and 2 seconds off-time intermittently drives the internal alarm.

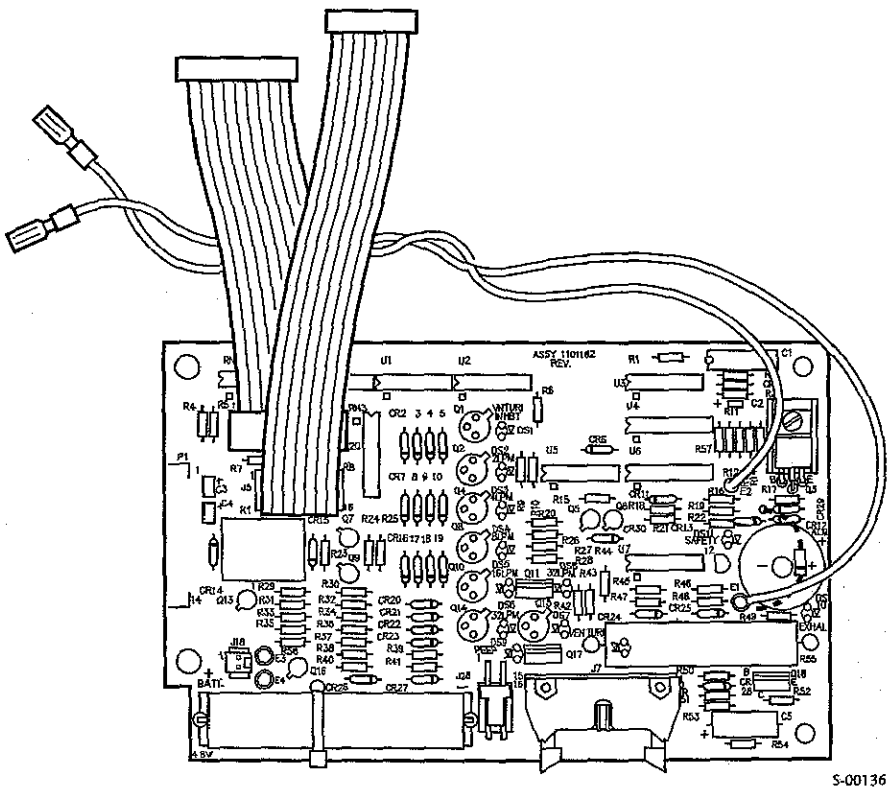

Figure 7-19. Alarm Driver PCA (current limiting)

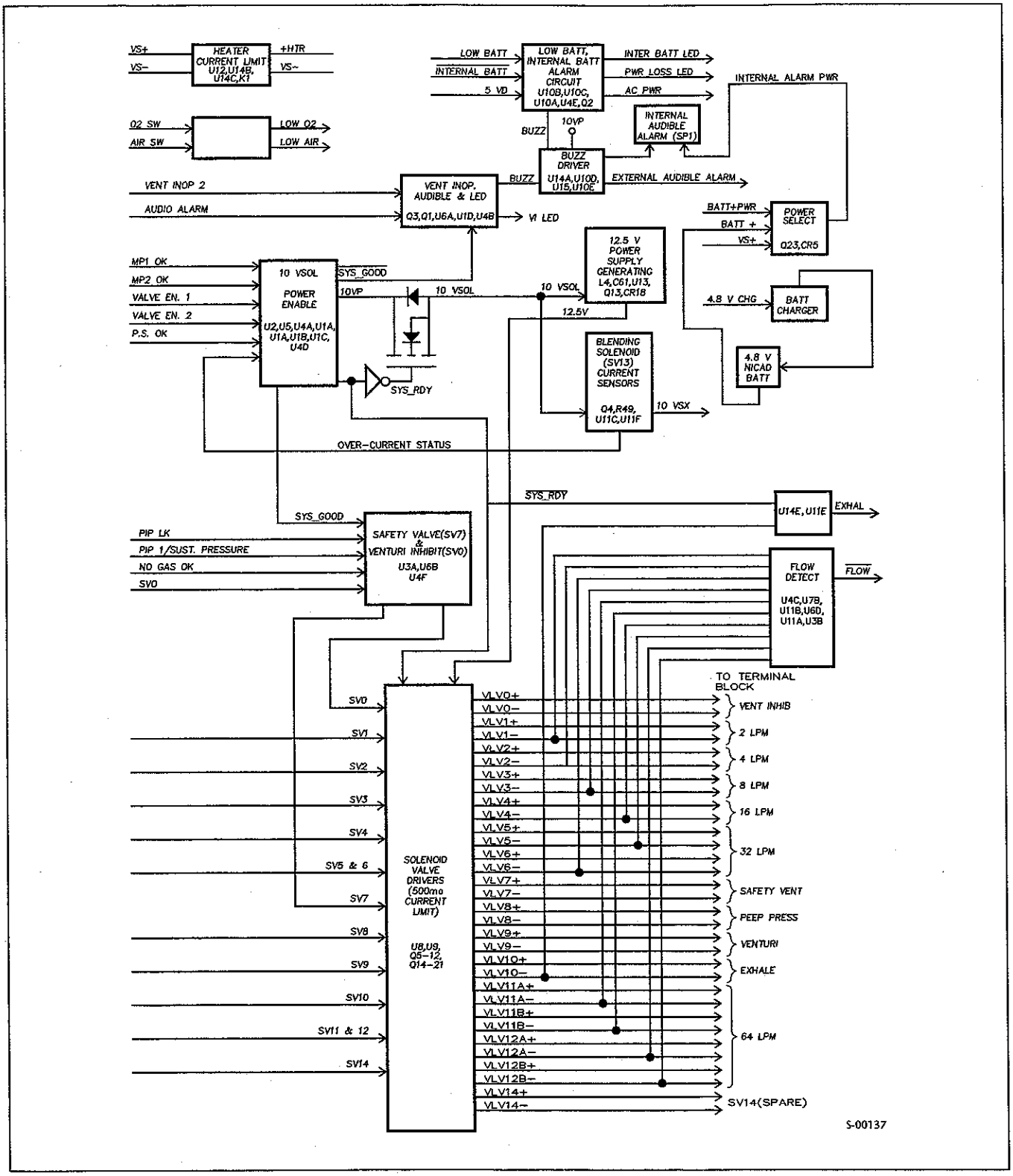

Figure 7-20. Alarm Driver PCA (current limiting) Block Diagram

7.1.11.3 Proximal/Differential Transducer PCA

The Proximal/Differential Transducer PCA (P/N – N-1175018) is located in the pneumatic compartment base assembly and its function is to convert the proximal and internal pressure signals to electrical signals for pressure control and monitoring purposes; its other function is to control the 0_2 blender gases. Following is a detailed description of each function of the PCA.

The Proximal and Internal Pressure Conversion part of the PCA provides the following outputs:

- PT2
- Prox + and Prox -
- PT1

The PT2 signal is converted from the proximal pressure reading of 0 - 100 cmH_2O. The proportional voltage of 0 - 2.344 Vdc is accomplished by using a constant current source (CR1, CR2, U1A, and R10) and an instrument amplifier circuit (U3, U4, and U1D). The output of the differential amplifier (U3 and U4 which are part of the instrument amplifier) is connected to PT2 and Proximal op-amps which convert the differential signals to single-ended signals. The PT2 op-amp output is reference to 2 V. The output of the Proximal op-amp is reference to an analog ground. The signal is directly connected to an outside monitoring device. A high-impedance resistor network (R29, R30, and R31) divides the Proximal pressure signal down to provide internal circuit protection. The voltage produced by this circuit is 0 - 1 Vdc, which is directly proportional to 0 - 100 cmH_2O.

The PT1 signal is converted from a 0 – 100 cmH_2O pressure reading to a -0.298 Vdc – +2.126 Vdc electrical signal in the same manner as PT2.

The Controlling Air/Oxygen Gases Blender part of this PCA controls the flow of blended gases from the 0_2 blender and keeps the Accumulator pressure at 38 psi including:

- Upstream Pressure
- Downstream Pressure
- Low Flow Oxygen or Air Pressure Alarms
- Low Manifold Pressure Alarm (PS3) 8 psi

When the Accumulator pressure drops to approximately 28 psi, SV13 is turned off, opening the pilot valve allowing flow and building up pressure in the Accumulator. When accumulator pressure is within 2 psi of the line Pressure, SV13 energizes and the pilot valve turns off.

The Proximal Differential Transducer PCA provides 10 V (10VSX) for SV13. The Upstream and Downstream Pressure Tubing is connected to the differential pressure transducer PT3.

Measuring the Upstream and Downstream pressure controls flow. This pressure is fed to the pressure transducer (PT3) which converts the pressure to a differential electrical signal. The resultant voltage is amplified by an instrument amplifier (U9A, U9B, U9C and associated discrete components) which amplifies and converts the signal to a single-ended signal. The output is then compared with a 3.75 V reference voltage (set up by R63 and R74)) by comparator U10A. The output signal of this comparator is inverted by U10B whose output is connected directly to the SV13 driver (Q4). The driver status can be observed by watching DS1 that is lit when the solenoid energizes.

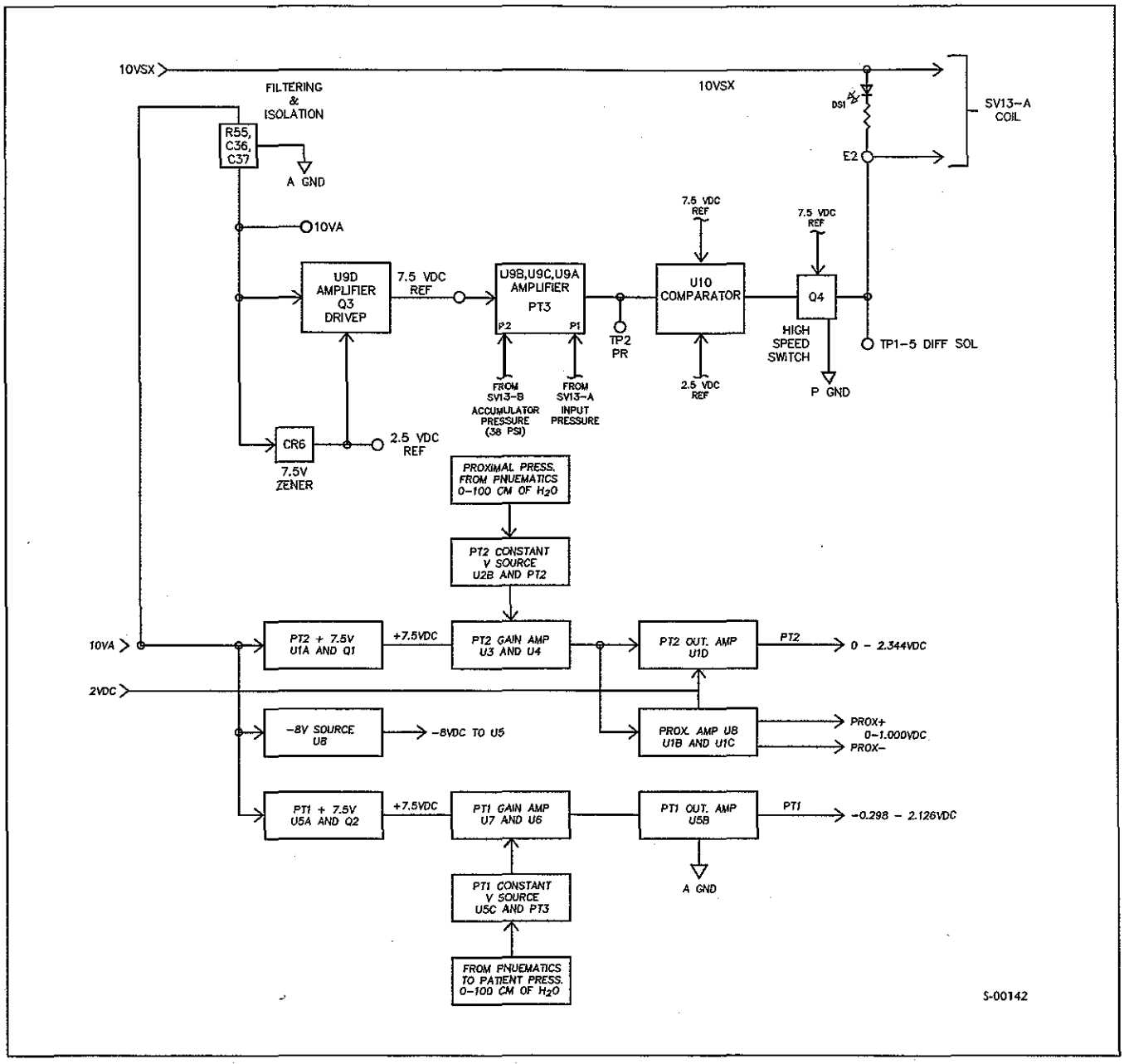

Figure 7-21. Proximal/Differential PCA Block Diagram

7.1.12 Pneumatic Assembly Functional Descriptions

7.1.12.1 IMV Regulator (R5)

R5 is gray and is located at the rear of the pneumatic base, on the bottom right side, adjacent the transducer PCA. It is calibrated to 65.2 cmH_2O. During a delivered breath, the IMV regulator provides pressure to the back of the exhalation diaphragm through SV10 (IMV/PEEP select solenoid valve).

7.1.12.2 PEEP Regulator (R6)

R6 is located at the rear, bottom left side, of the pneumatic base. It is gray and is visibly different from the IMV regulator due to its dome port. The one-to-one regulator (a 1 cmH_2O of pressure on the dome delivers 1 cmH_2O through the output) is controlled by SV8 (PEEP solenoid valve). When the ventilator is set to PEEP/CPAP, the PEEP regulator applies pressure

to the back of the exhalation diaphragm when SV10 is deenergized. When a breath is *not* being delivered and there is no PEEP to apply pressure to the back of the exhalation diaphragm, the patient exhales to atmosphere.

7.1.12.3 Air Regulator (R1)

R1 is located at the rear of the pneumatics base, on the top right side, near the transducer PCA. It is calibrated to 38 psi (35 psi for CE marked 500 models) and supplies 38 psi pressure to the oxygen blender, oxygen regulator dome, IMV, PEEP, mini regulators, and SV9. The R1 check valve allows flow into the ventilator, does not allow the air that has entered to return, and is connected by an attaching inlet manifold block.

7.1.12.4 Oxygen Regulator (R2)

R2 is positioned at the rear of the pneumatics base on the top left side. It is calibrated to the output pressure of R1 using a differential capsuhelic gauge -5 to +5 cmH_2O to approximately -0.9 cmH_2O. It has a bleed on the bottom rear, left side. It provides the equivalent pressure to that delivered by R1 to the blender. If R1 drops in pressure, R2 drops equally.

7.1.12.5 O_2 Blender

The O_2 Blender is located just behind the O_2 blender control knob located on the front of the pneumatic base. It is a long aluminum block with brass sleeves on at each end. It is calibrated to ±3 percent of the control knob setting, with the exception of 21% and 100% which are calibrated ±2%. When the O_2 control knob is positioned at 21, the oxygen plunger shaft (to which the knob attaches) is turned back, blocking any flow coming from the oxygen portion of the blender. When the control knob is positioned at 100, the oxygen plunger shaft is turned all the way in, blocking flow from the air side of the blender. All other settings allow a mixture of the gases producing different oxygen percentages. The blended gases are shared by the blended gas outlet, and the To Patient port.

7.1.12.6 Mini Regulator (R7)

R7 is located at the front of the pneumatic base to the left of the blender assembly. It is calibrated to 13 psi to supply a 13 psi PEEP pressure to SV8 and the safety valve regulator (R8). There is a lock-down ring under the adjuster, which is pushed down and tie wrapped after calibration.

7.1.12.7 Proportional Flow Manifold

The Proportional Flow Manifold is located in the front left portion of the pneumatic base and behind the To Patient port. It supplies the To Patient port and the blended gas outlet with gas from the blender. The regulator (R4) is calibrated to 18 psi and the flows are controlled by the use of a restrictor in the block under each solenoid. If the flow is 16 Lpm, a restrictor is not normally required.

7.1.12.8 Jet Venturi

A lower pressure is produced inside the exhalation block assembly to reduce the inadvertent PEEP/CPAP in the patient circuit. (Inadvertent PEEP/CPAP is unwanted pressure that is higher in the patient's circuit than the PEEP/CPAP set on the ventilator.) The solenoid (SV9) dutycycle varies to control the flow to the venturi inhibit solenoid (SV0). SV0 is energized during exhalation to allow the flow to go to the jet venturi. The jet flow through the venturi creates an area of low pressure. This low pressure aids the exhalation flow and removes the inadvertent PEEP/CPAP.

7.1.13 Pneumatic Diagrams

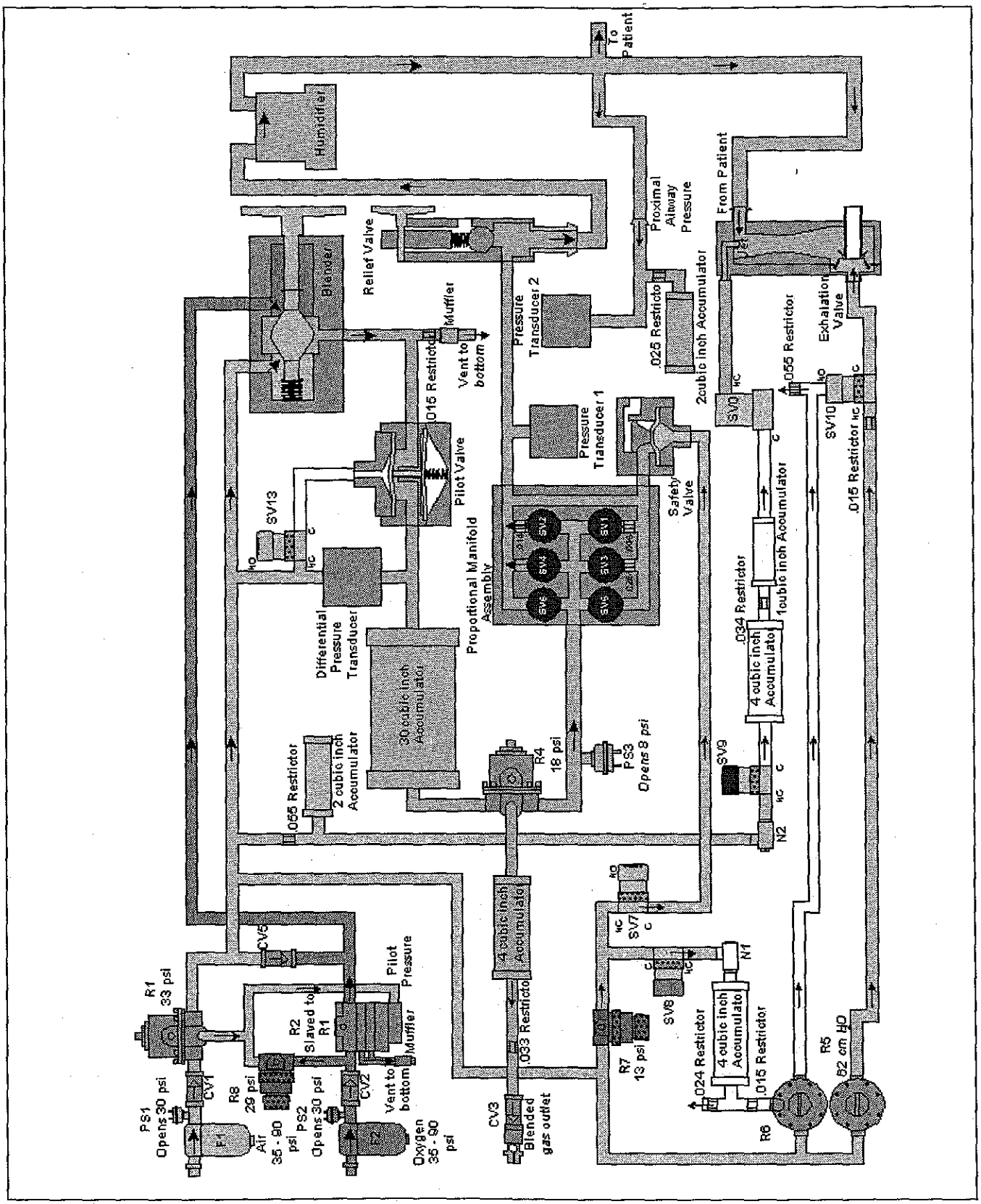

Figure 7-22. Infant *Star* 500 Inspiration Pneumatic Diagram

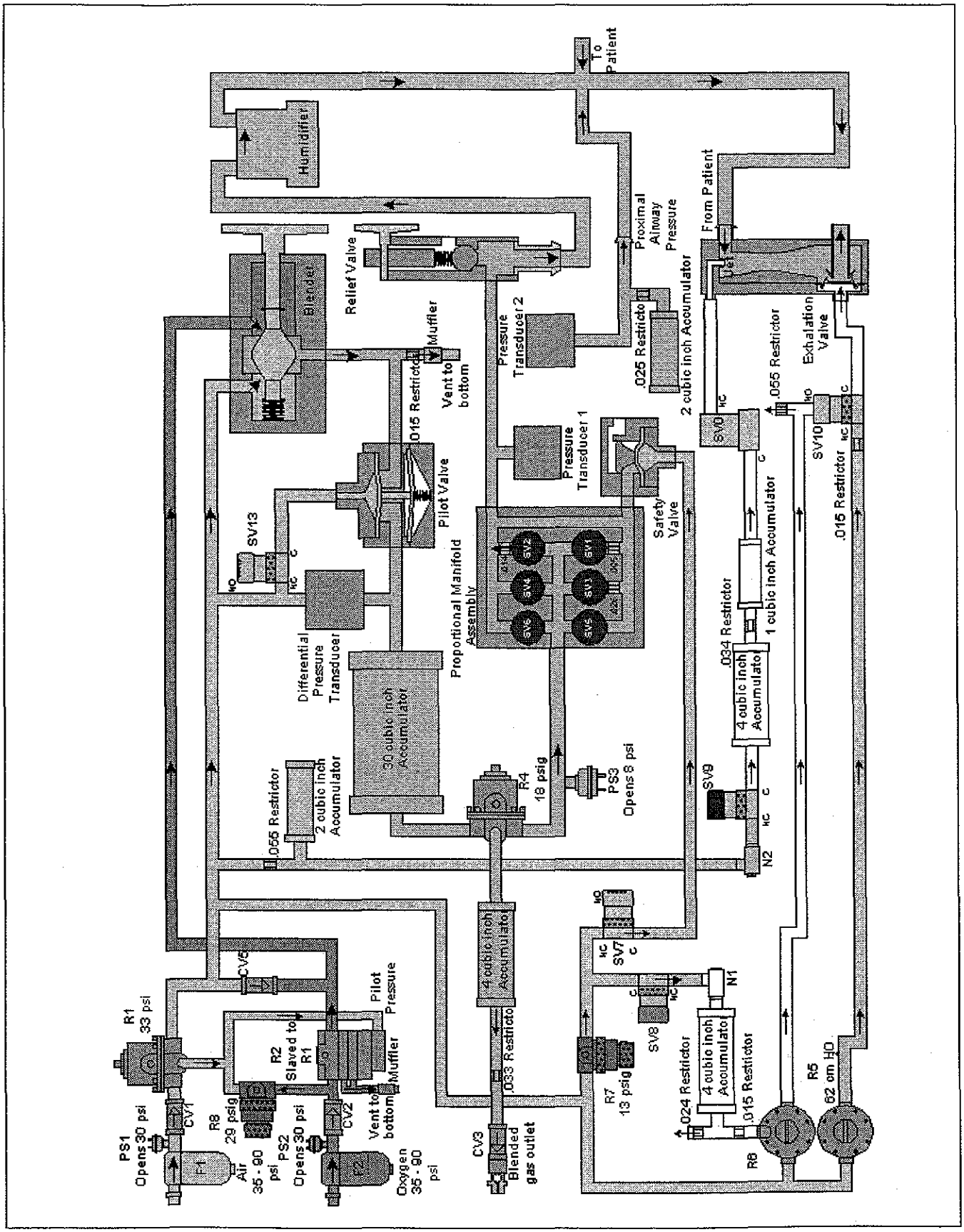

Figure 7-23. Infant *Star* 500 Exhalation Pneumatic Diagram

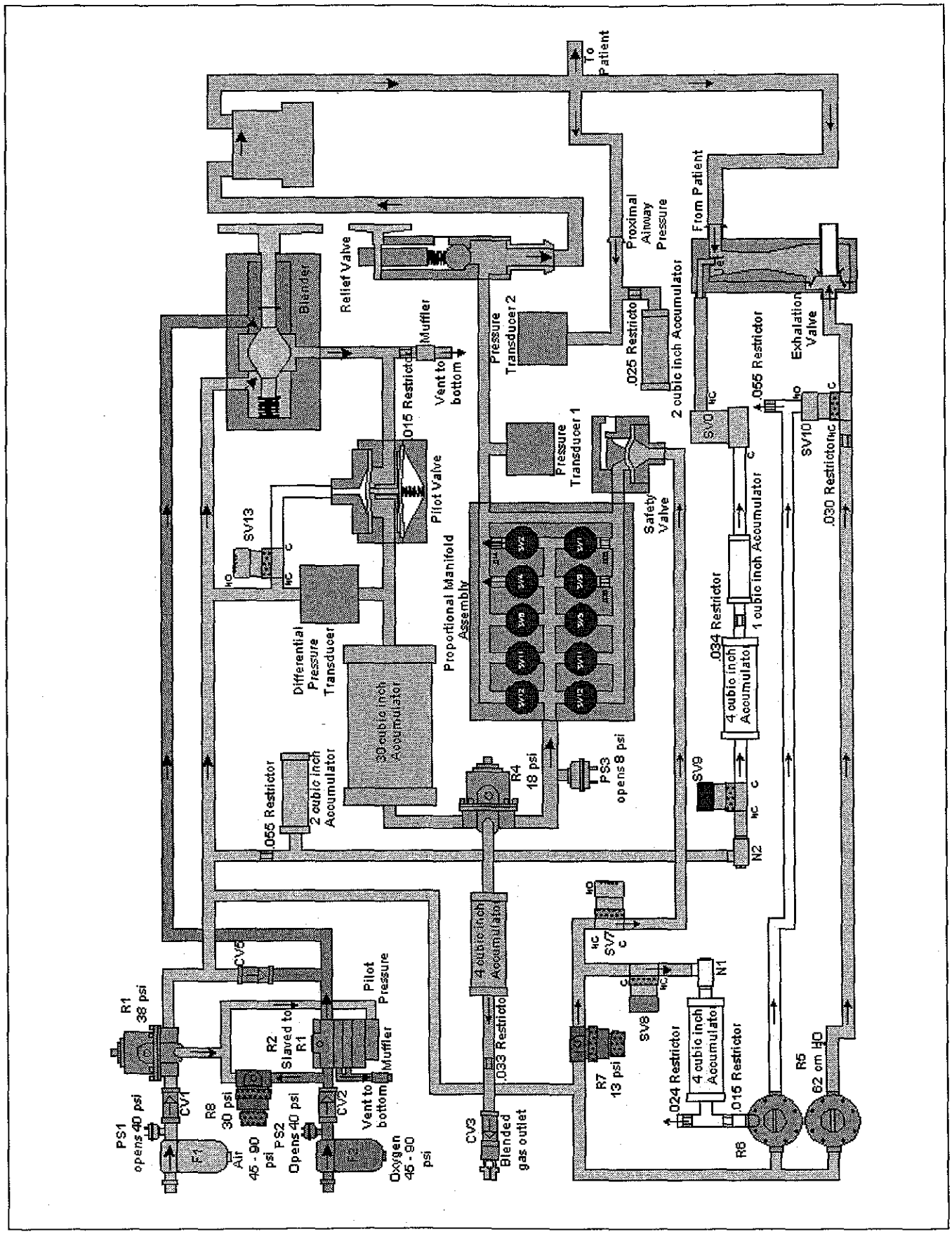

Figure 7-24. Infant *Star* 950 Inspiration Pneumatic Diagram

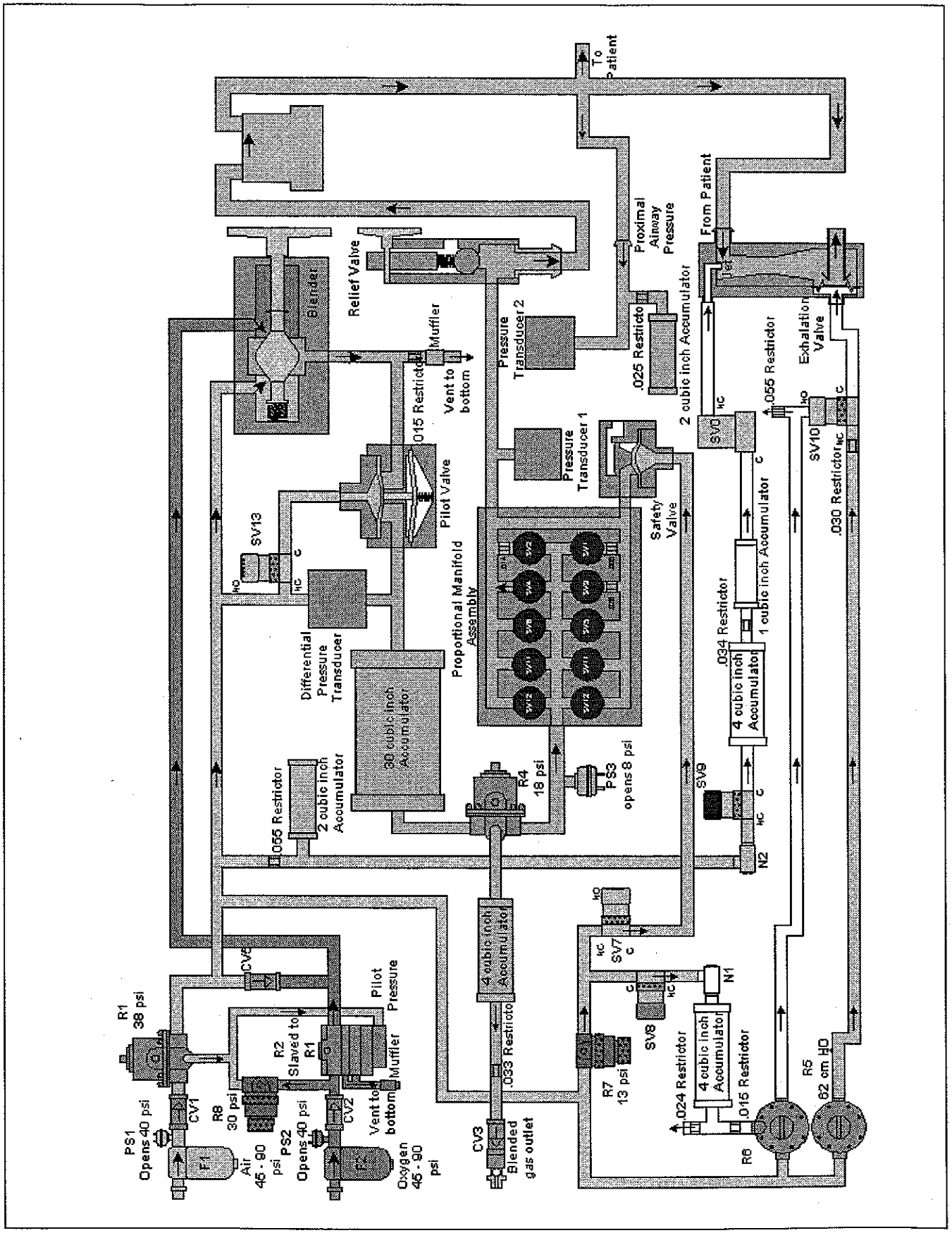

Figure 7-25. Infant *Star* 950 Exhalation Pneumatic Diagram

7.1.14 Electrical Interconnect Diagrams

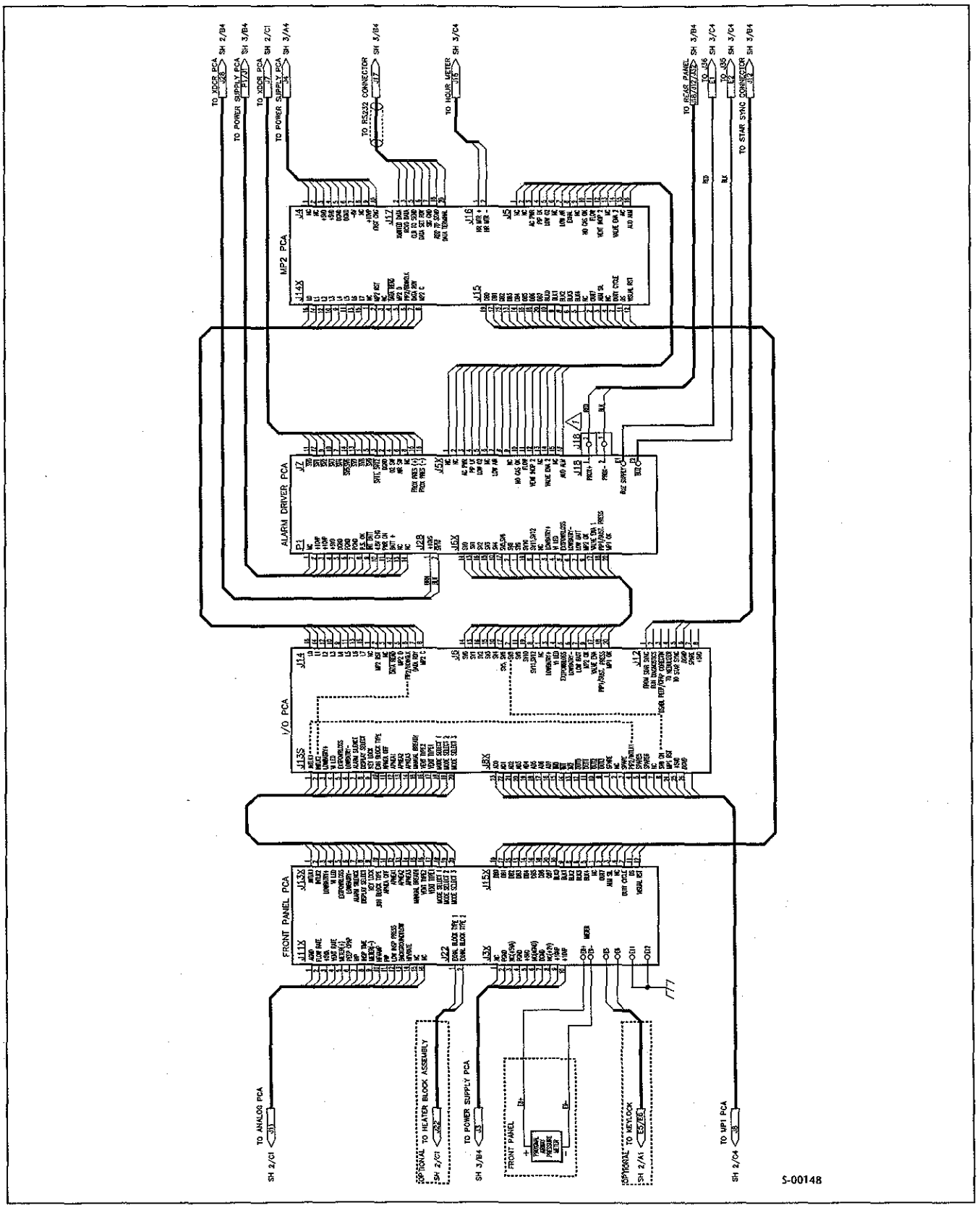

Figure 7-26. Original Infant Star Models 500/950 (1 of 4)

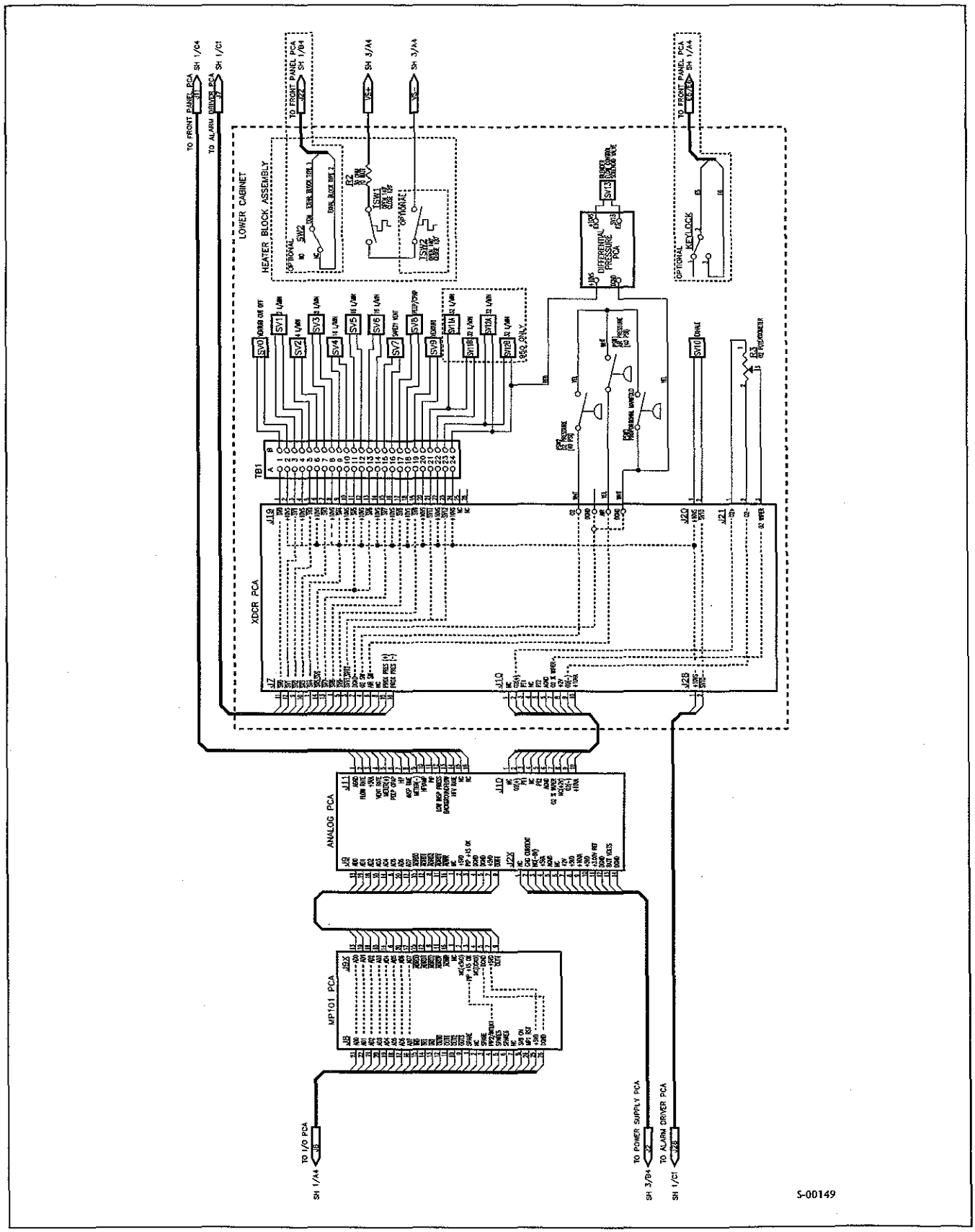

Figure 7-27. Original Infant *Star* Models 500/950 (2 of 4)

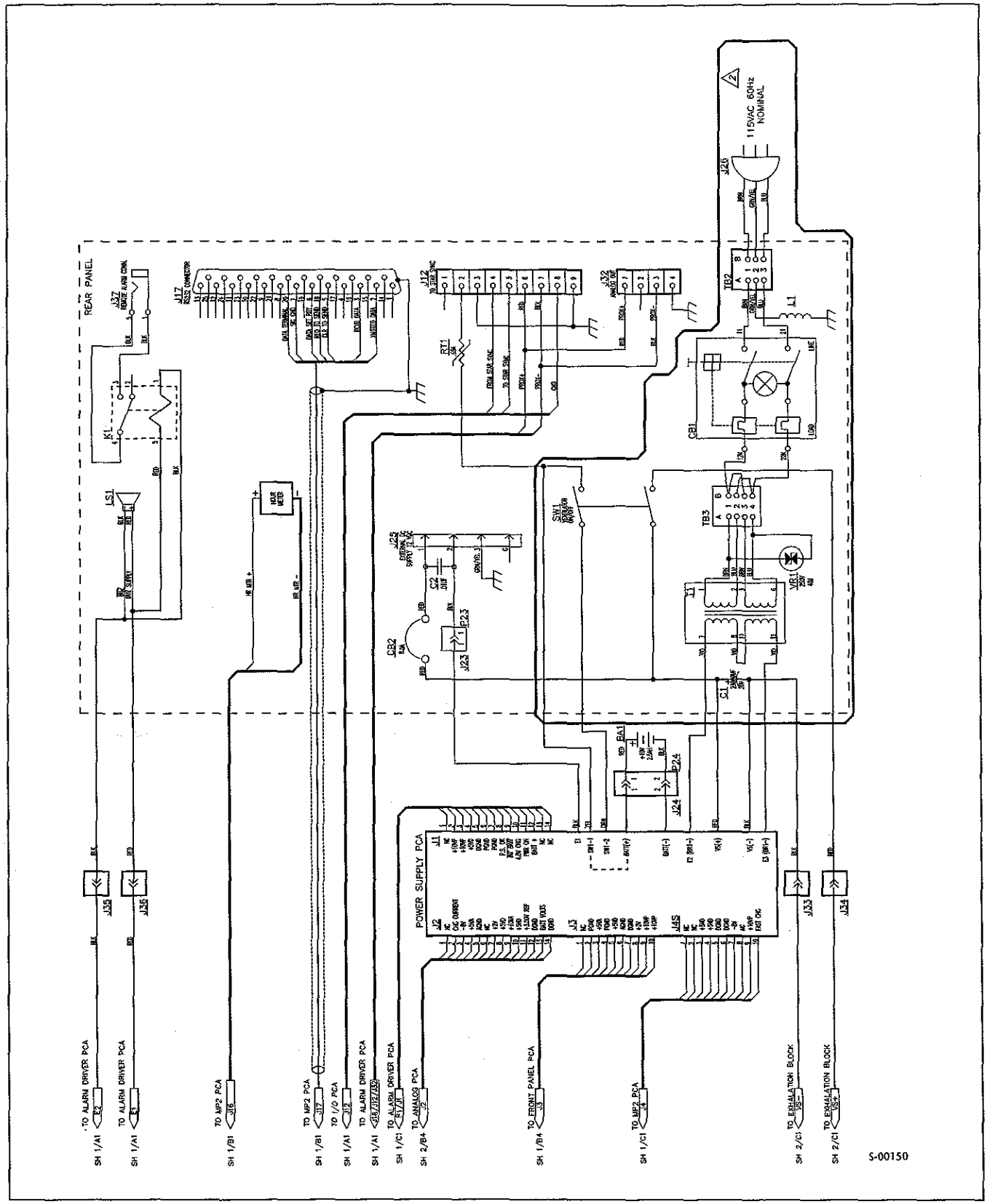

Figure 7-28. Original Infant *Star* Models 500/950 (3 of 4)

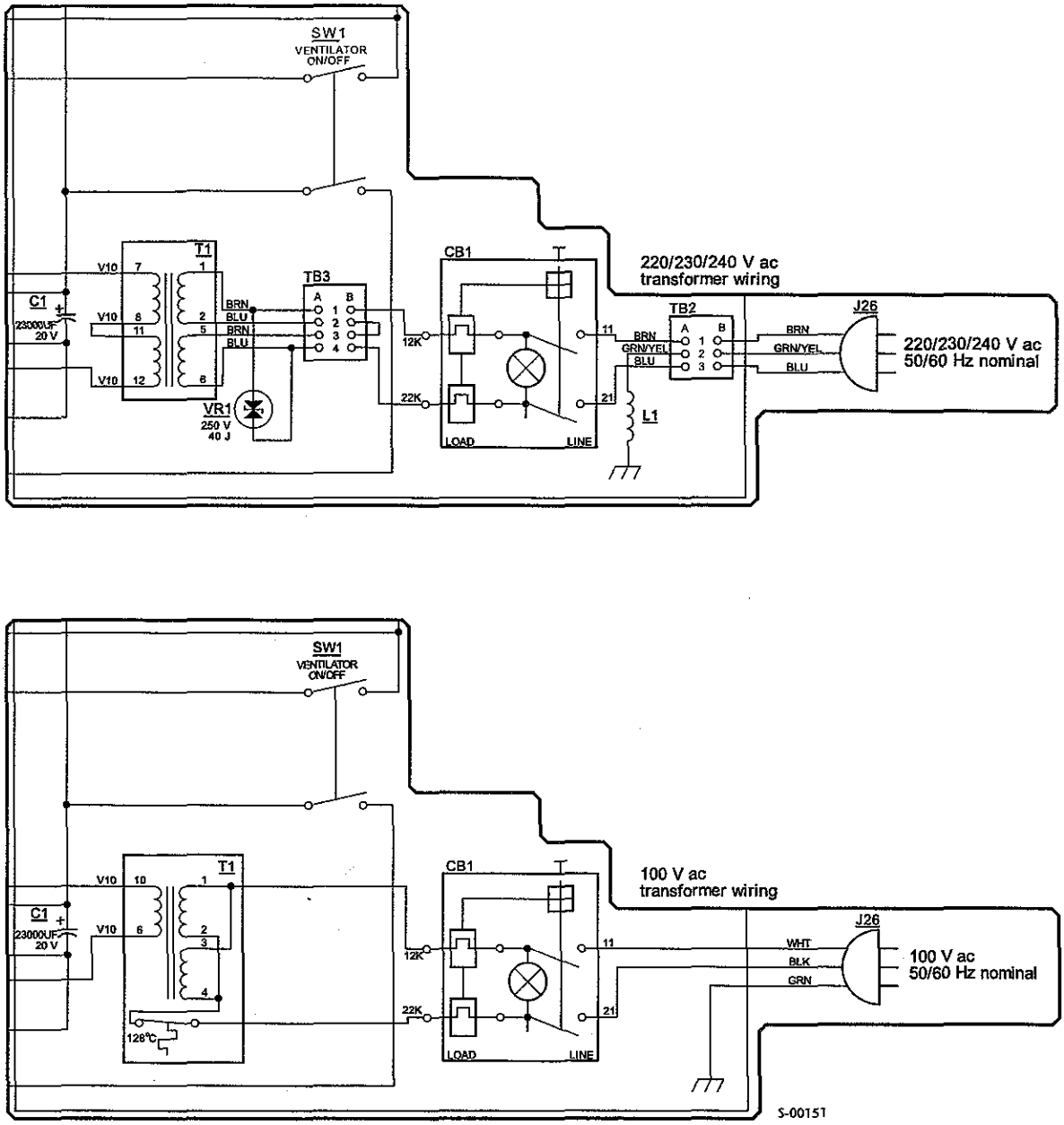

Figure 7-29. Original Infant *Star* Models 500/950 (4 of 4)

7.1.15 CE Mark Electrical Interconnect Diagrams

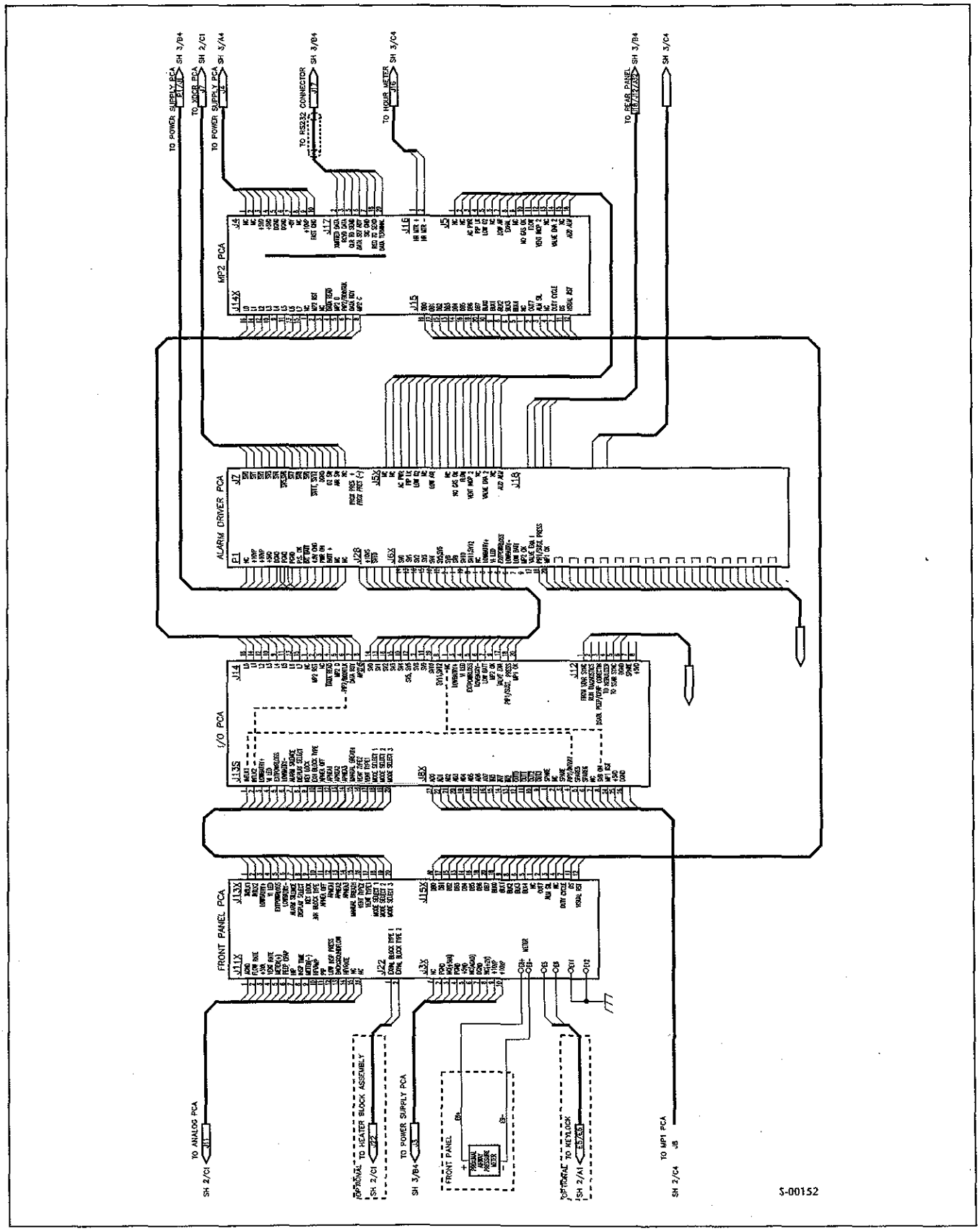

Figure 7-30. Infant *Star* Models 500/950 230 V (1 of 4)

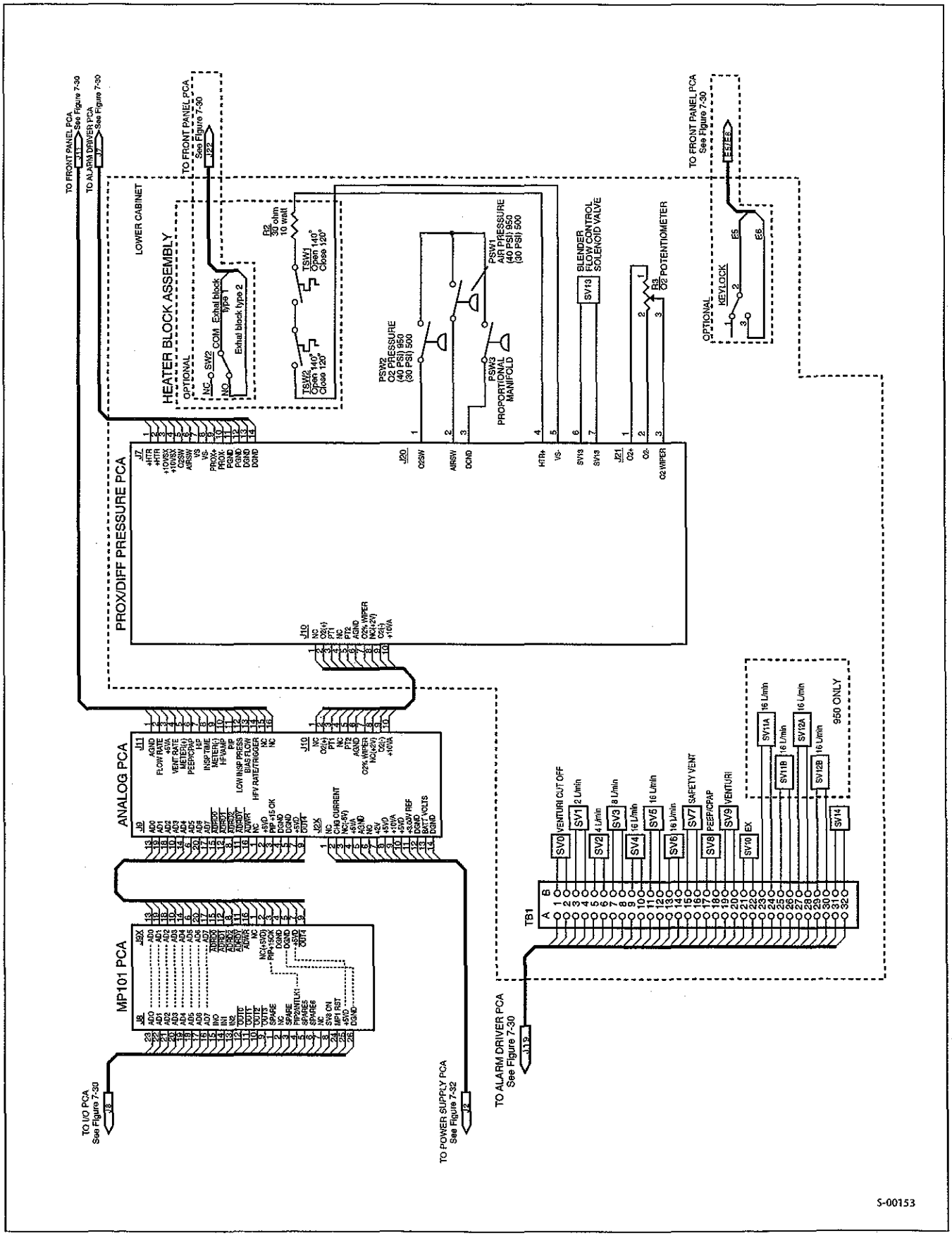

Figure 7-31. Infant *Star* Models 500/950 230 V (2 of 4)

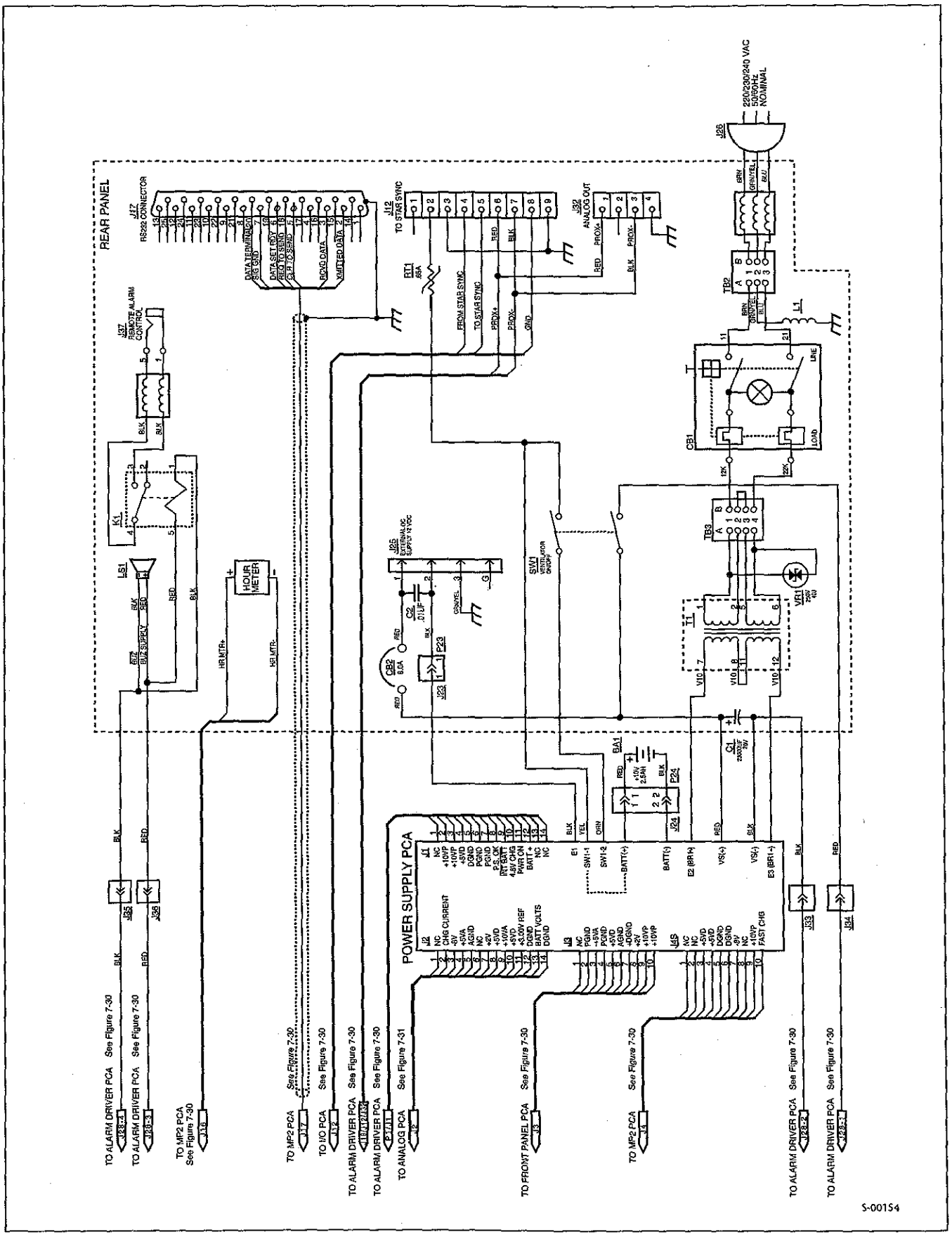
REAR PANEL
POWER SUPPLY PCA
220/230/240 VAC 50/60Hz NOMINAL
HOUR METER
TO ALARM DRIVER PCA See Figure 7-30
TO MP2 PCA See Figure 7-30
TO I/O PCA See Figure 7-30
TO ALARM DRIVER PCA See Figure 7-30
TO ALARM DRIVER PCA See Figure 7-30
TO ANALOG PCA See Figure 7-31
TO FRONT PANEL PCA See Figure 7-30
TO MP2 PCA See Figure 7-30
TO ALARM DRIVER PCA See Figure 7-30
TO ALARM DRIVER PCA See Figure 7-30
S-00154

Figure 7-32. Infant *Star* Models 500/950 230 V (3 of 4)

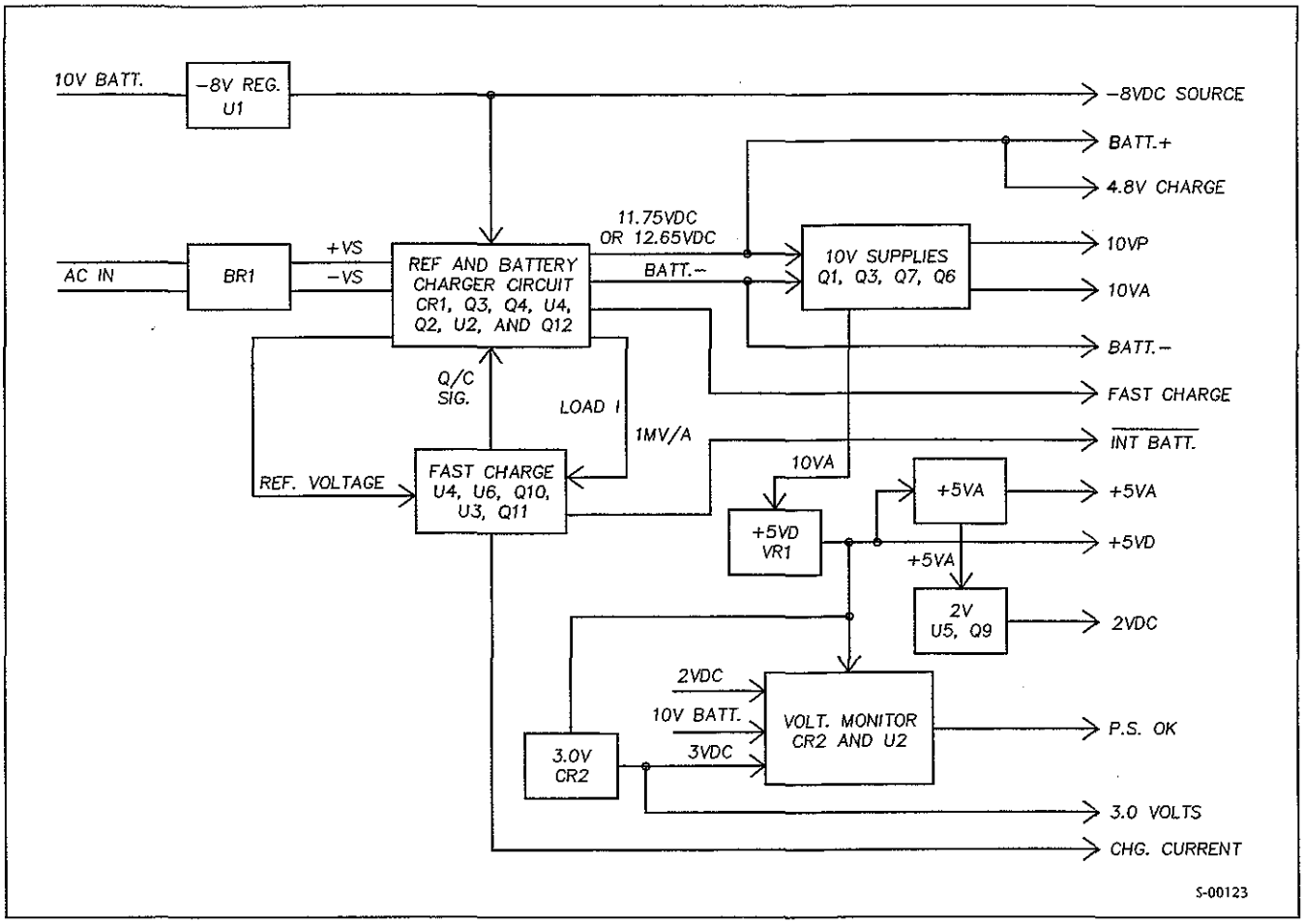

Figure 7-33. Infant *Star* Models 500/950 230 V (4 of 4)

SECTION 8

Hardware Identification

8.1 Hardware Identification

The following assemblies and identifying components are included in this section:

- Yoke
- Front Cover
- Rear Cover
- Pneumatic Base
- Pneumatic console
- Relief Valve
- O_2 Blender/Flow control

NOTE:

Part numbers are provided for convenience of identifying components. They are not intended to be used to order parts, as they may not be accurate with the latest part number for a given component. When ordering parts, numbers should be verified in the latest Price List or by contacting Mallinckrodt at 1-800-635-5267, press 2 for Technical Support.

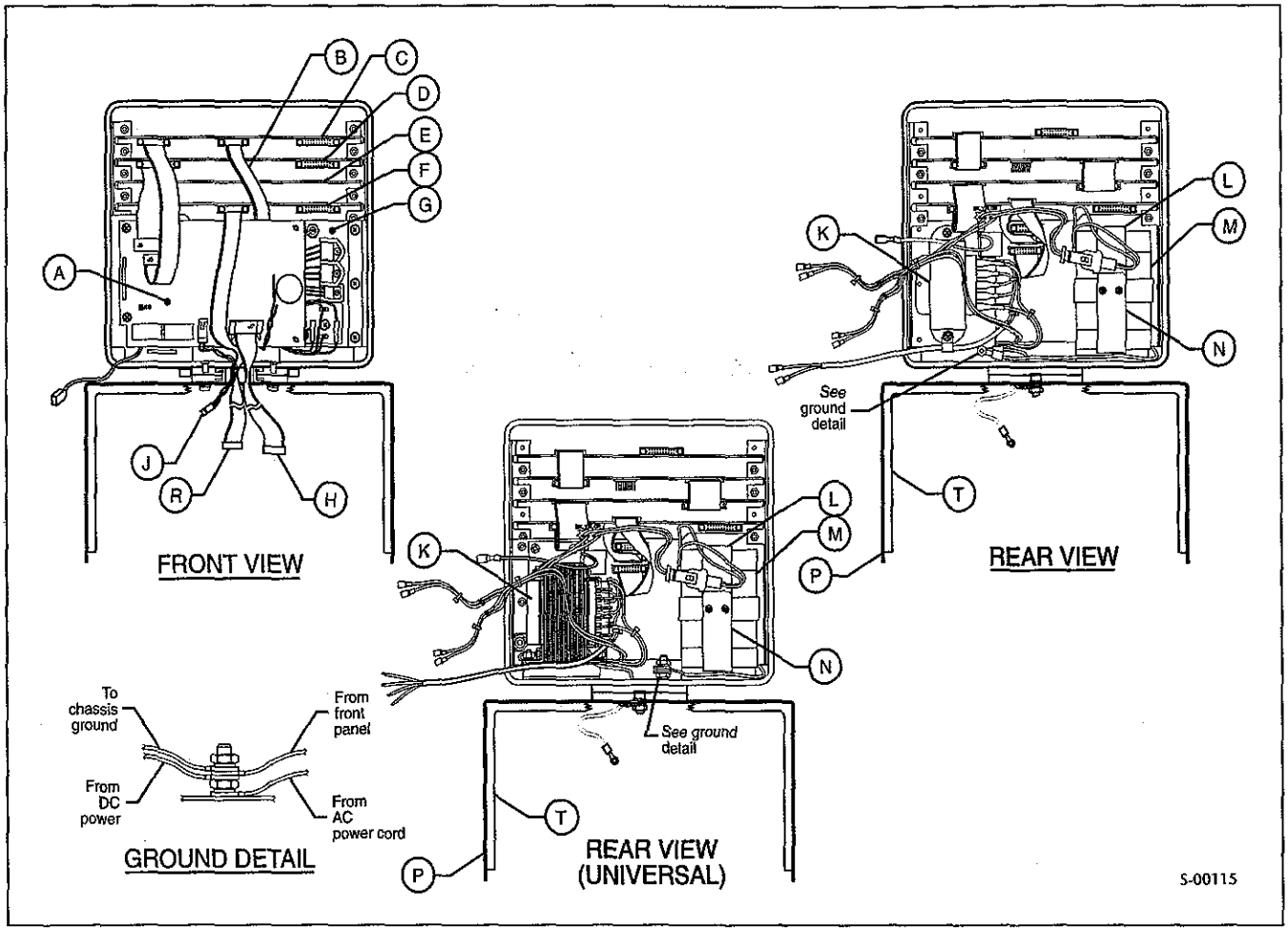

Figure 8-1. Yoke Assembly

NOTE:

The front panel ground has been moved to the bridge rectifier on latest Infant *Star* 500/950 ventilators

Table 8-1: Yoke Assembly Parts List

Reference	Description	Part Number
A	Alarm Driver PCA	N-1101162-SP
	Current Limiting Alarm Driver PCA	N-1175017-SP
B	Cable Assembly J-4	N-1101241
C	MP-2 PCA responsible for display, shows Soft Rev.	N-1101156-SP
D	I/O PCA light low batt, ext power loss	N-1101157-SP
E	MP101 PCA - Brain of unit	N-1101345-SP
F	Analog PCA	N-1175040-SP
G	Power Supply PCA	N-1101160-SP
H	Cable Assembly, J-7	N-1101239
J	Cable Assembly, J-28	N-1101235
K	100 Vac Transformer	N-1101350-SP
	Transformer Universal Assembly 115, 220 Vac	N-1150042-SP
L	Bracket, Battery Upper	N-2101307
M	Battery Assembly	N-1101230-SP
N	Bracket, Battery, Lower	N-2101306
P	Cover, Pneumatic Housing, ISV	N-2175025
R	Cable Assembly, J-10	N-1101240
T	Foam, Cover	N-2101389

If K1 Relay opens it will not allow a signal to the solenoids

B & R connection 14 Vdc

E23-E30 pressure transducer to Alarm board

E06 OR E08 - PIP window

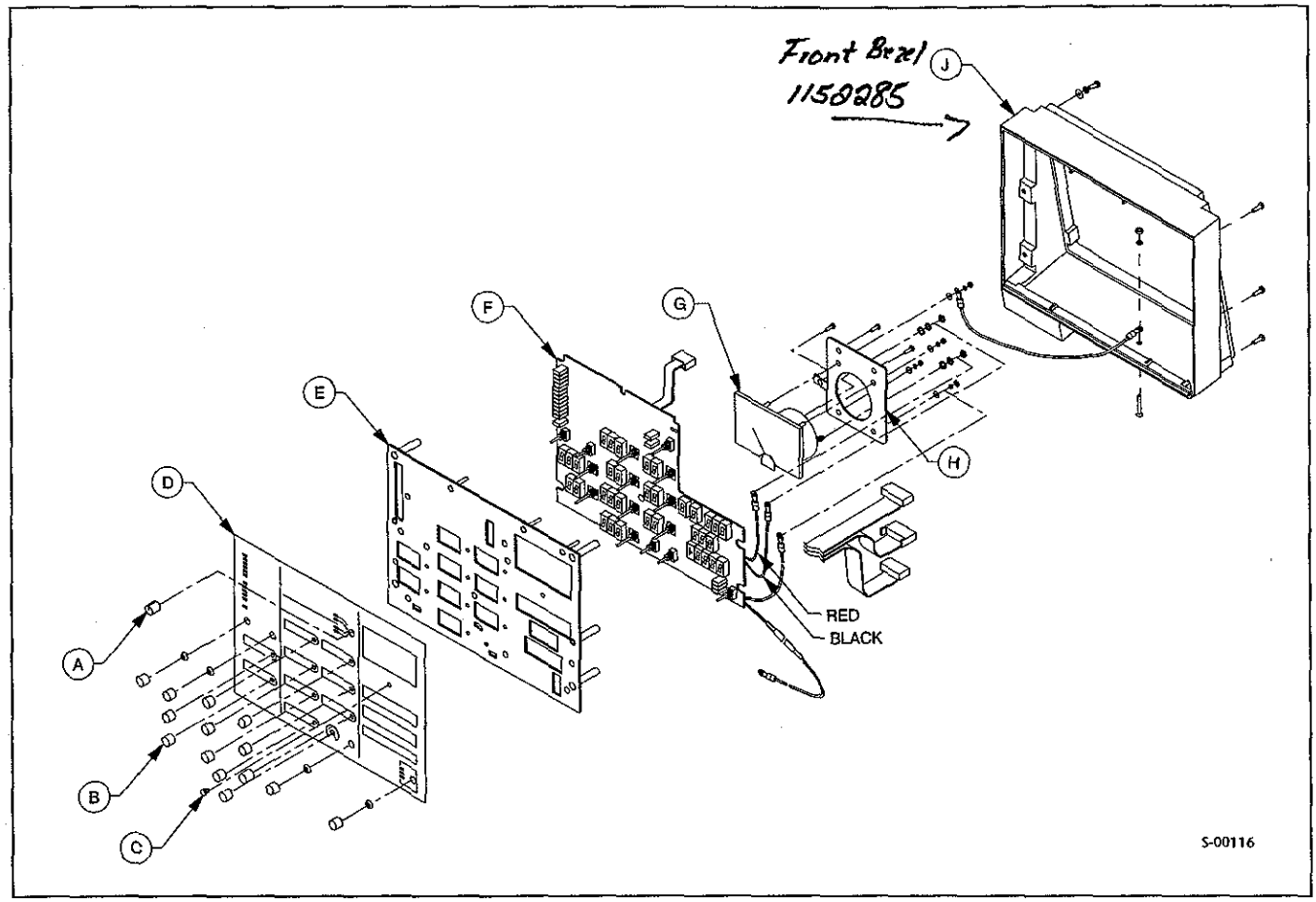

Figure 8-2. Front Cover Assembly

Table 8-2: Front Cover Assembly Parts List

Reference	Description	Part Number
A	Knob, .43 dia x .62L, Selection	N-2120020-2
B	Knob, .43 dia x .62L,	N-2120020-1
C	Plug, 3/16 Hold x 11/32 Head, Nylon	N-4800201
D	Overlay, Front Panel, Model 500 #109.28	N-9910371
	Overlay, Front Panel, Model 950	N-9910764
E	Sub-Panel, ISV Front	N-2175018
F	Front Panel PCA, Model 500	N-1150012-SP
	Front Panel PCA, Model 950	N-1195012-SP
G	Gauge, 10 to 120 cmH_2O	N-4300025
H	Meter Bracket	N-2150035
J	Front Cover/Bezel Assembly	N-1175015

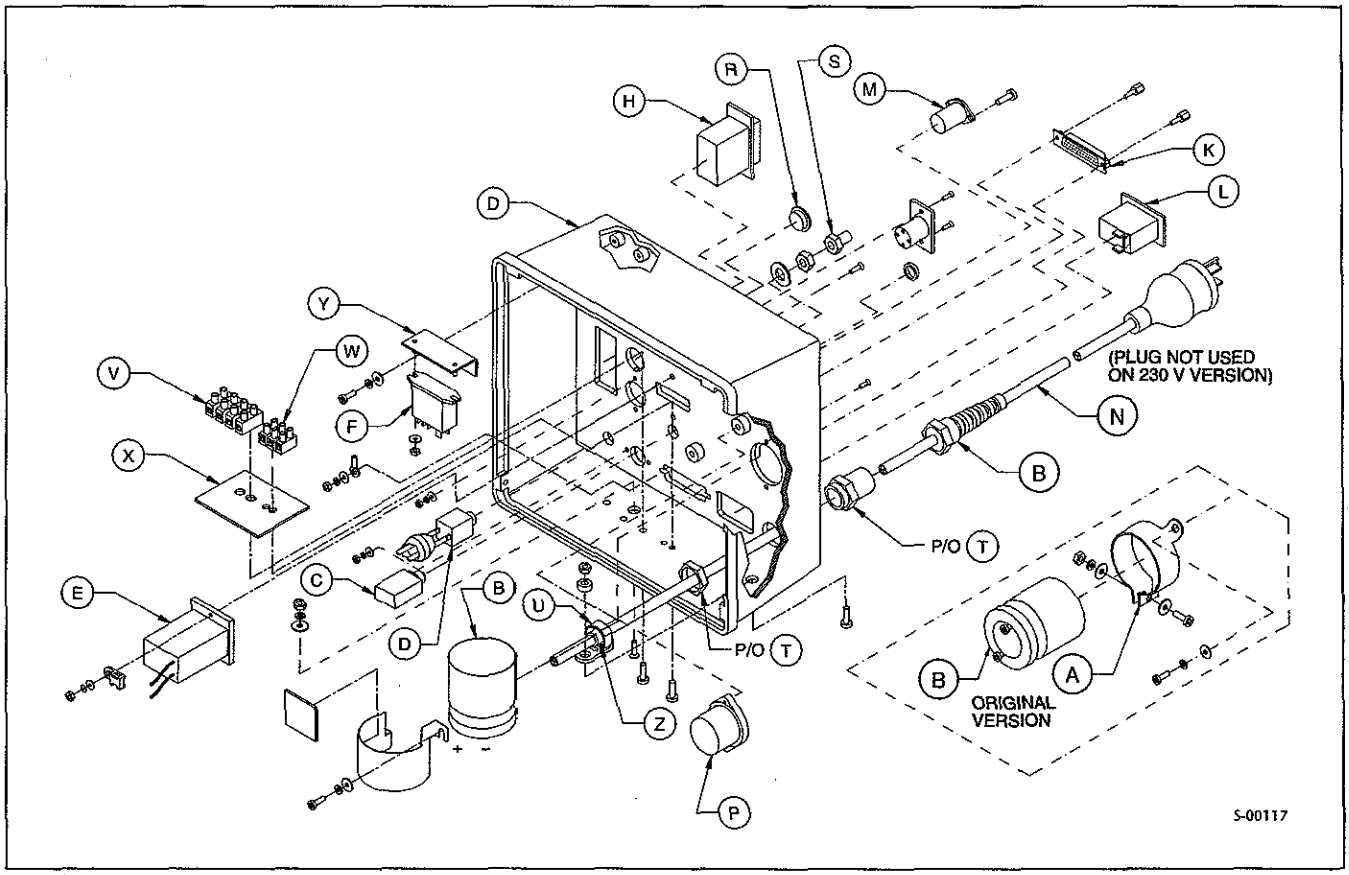

Figure 8-3. Rear Cover Assembly

Table 8-3: Rear Cover Assembly Parts List

Reference	Description	Part Number
A	Clamp, Capacitor New Style	N-2150029
B	Capacitor, 2300 uf, 20V, 20%	N-6700006
C	CKT BKR, SPST, 8A/250V	N-7600006
D	Cable Assembly, Remote Alarm Connector J-37	N-1800010-SP
E	Hour Counter Assembly	N-1101255
F	Relay SPDT, 12Vdc, 10A, .19QCD	N-5150011
G	Cover, Rear, ISV	N-1175011
H	Circuit Breaker, DPST, 2A, 115Vac Lamp, GRN	N-7600043
	Circuit Breaker,1.2A,115V, Universal Transformer	N-7600060
	Circuit Breaker,.6A,230V, Universal Transformer	N-7600059
K	Cable Assembly, J-17, RS-232	N-1101264
	Cable Assembly, J-17, RS-232 Shielded (CE model)	N-1101282
L	Switch, Rocker, DPDT, 3A @ 250Vac, Black	N-7600004
M	Connector Assembly, Wired Proximal	N-1101292

Table 8-3: Rear Cover Assembly Parts List (continued)

Reference	Description	Part Number
N	Cord, Power W/Hospital Grade Plug	N-8109001
	Cord, Universal Power	N-8109010
P	Alarm, Audio, Modified	N-2101301
R	Cable Assembly, Star Sync, Internal	N-1800077
S	Switch Seal, Push Button 3/8-32 Cover, Alarm Remote	N-7800169
T	Strain, Relief	N-7800026
U	Anchor Mount Cable Tie, 14.7 Large	N-3440026 N-3440027
V	Terminal Block, 4 POS	N-2120051
W	Terminal Block, 3 POS	N-2120052
X	Insulation Terminal Block	N-2120050
Y	Bracket, Relay, ISV (B/C)	N-2175008
Z	Torrid, Ferrite, CYLD, 196 OHM, 100MH$_Z$	N-7800228

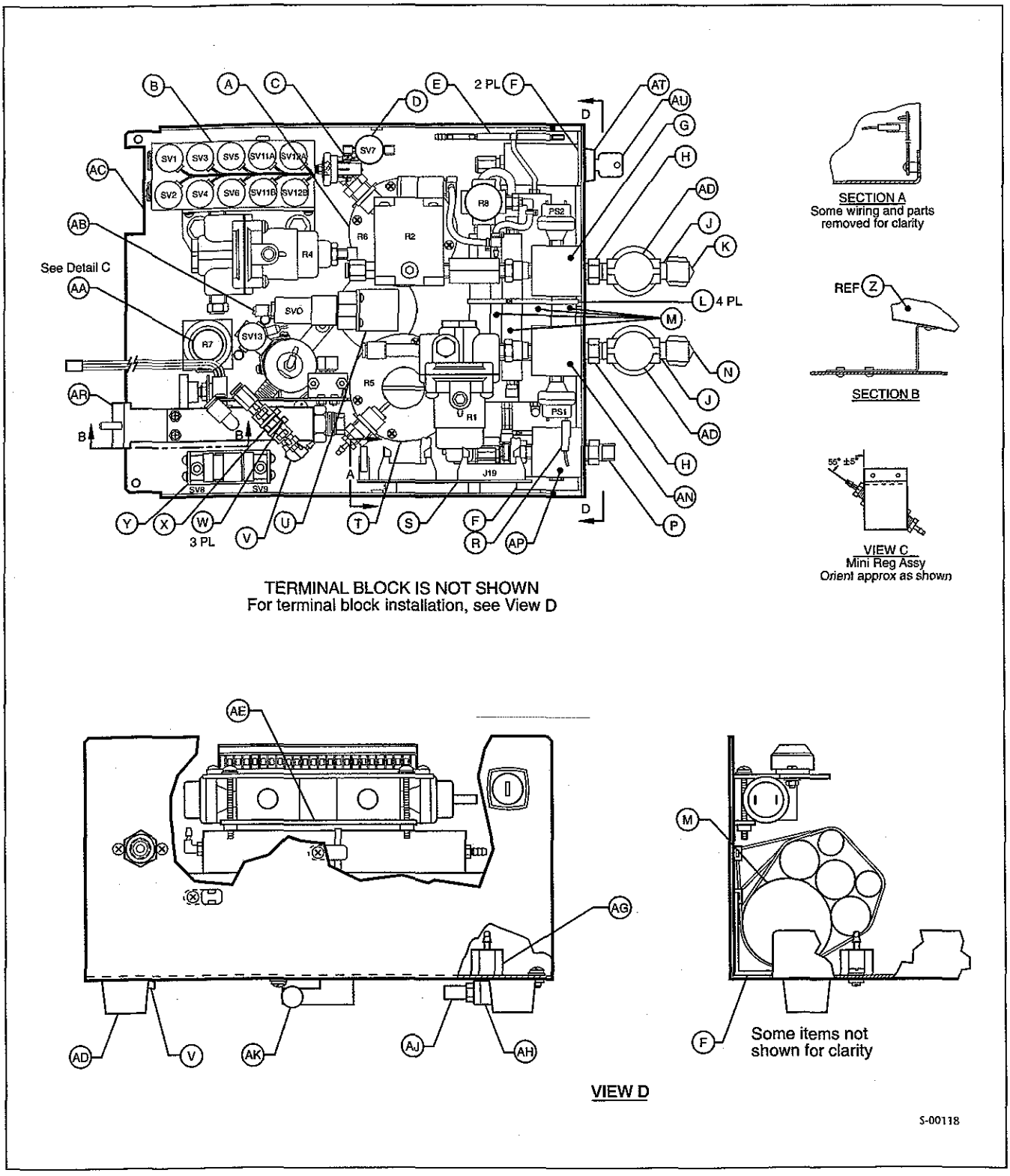

Figure 8-4. Pneumatics Base Assembly

Table 8-4: Pneumatics Base Assembly Parts List

Reference	Description	Part Number
A	PEEP Regulator	N-1700002-SP
B	Proportional Manifold Assembly, Model 500	N-1150022-SP
	Manifold Assembly, Proportional HFV, Model 950	N-1121275-SP
C	Double Spade Disconnect Adapter, Male	N-7700137
D	SV7 Solenoid	N-1101229-SP
E	PEEP Restrictor and Tubing Assembly	N-1101228
F	Foam Accumulator	N-2101288
	O_2 Regulator Assembly, 1/8-inch NPT, 35 psi (CE model and overhauled since January 1999)	N1195006-SP
G	O_2 Regulator Assembly	N-1101331-SP
	O_2 Regulator Assembly, 1/4-inch NPT, 38 psi (35 psi CE model 500)	N-1150068-SP
H	1/4" to 1/4' NPT Bushing Chrome Nipple Fitting	N-3600151
	1/8-inch NP{T Chrome Nipple (CE model and overhauled since January 1999)	N-3600174
J	Chrome 1/4 x 1/4" NPT Elbow Fitting	N-3600150
	1/8-inch NP{T 90° Elbow Fitting (CE model and overhauled since January 1999)	N-3600175
K	O_2 Body CGA 1240 x 1/4" Chrome	N-3600153
	O_2 Body Adapter dCGA 1240 x 1/8 inch (CE model and overhauled since January 1999)	N-3600176
L	Cable Tie 14.5 LG .19 Wide NYL	N-3440009
M	Accumulator Bundle Assembly	N-1101215
	Bundle Assembly	N-1121215
N	Air DISS FTG Body Adapter, 1/4" NPT Chrome	N-3600152
P	DIS Demand Check Valve 1/4" NPT O_2 Fitting Chrome	N-3600154
R	Cable Assembly, Pres. Sev (1,2,3)	N-1101303
S	XDCR PCA (non-CE mark ventilator)	N-1101163-SP
	Proximal/Differential Transducer PCA (CE model ventilator)	N-1175018-SP
T	IMV Regulator Assembly	N-1700056-SP
U	Sleeve, Pole Mount	N-2100112
V	Prt/restrictor Assembly Bleed	N-11012667
W	CBI tie 3.9 LG 0.10 Wide NYL	N-3440008
X	Muffler/Bleed part Assembly	N-1101268-SP

Table 8-4: Pneumatics Base Assembly Parts List (continued)

Reference	Description	Part Number
Y	Bracket Assembly SV-8, SV-9 solenoids, Model 500	N-1101227
	Bracket Assembly SV-8, SV-9 Solenoids, Model 950	N-1121227
AA	Mini REgulator Assembly	N-1101253-SP
AB	Inhibit Assembly, Venturi SV-0 Solenoid	N-1101258-SP
AC	Base, Pneumatic, Silk-screen	N-2190003-21
AD	Foot, Rubber, 1-18 D x 7/8 Tall Black	N-4800204
AE	Bracket, Mounting Terminal Block	N-2101338
AG	Fitting, barbed, 1/8 Tubing - 1/8 NPT	N-3610071
AH	Fitting, ELL, 1/8 NPT x 10-32	N-3600182
AJ	Muffler, 10-32, Sintered	N-4800118
AK	Knob, Thumb Screw, Knurled, N08	N-5400004
AM	Filter Assembly 1/4" NPT 5 Micron	N-4402005
	Filter Assembly 1/8" NPT 5 Micron (CE model and overhauled since January 1999)	N-4402068
	Filter Element, 5 Micron	N-4403006
AN	Air Regulator Assembly	N-1101202-SP
	Air Regulator Crossover Assembly (CE models only)	N-1101529-SP
AP	Blender Gas Outlet Assembly	N-1101221-SP
AR	O_2 Blender/Snap Assembly	N-1220068-SP
	O_2 Blender Assembly (CE models only)	N-1195007-SP
AS	Manifold Assembly, Proportional HFV, Model 950	N-1121275-SP
AT	Key Lock Assembly, Model 950	N-1195019-SP
	Key Lock Assembly (950 CE model only)	N-1800059-SP
AU	Replacement Key HFV	N-7600068

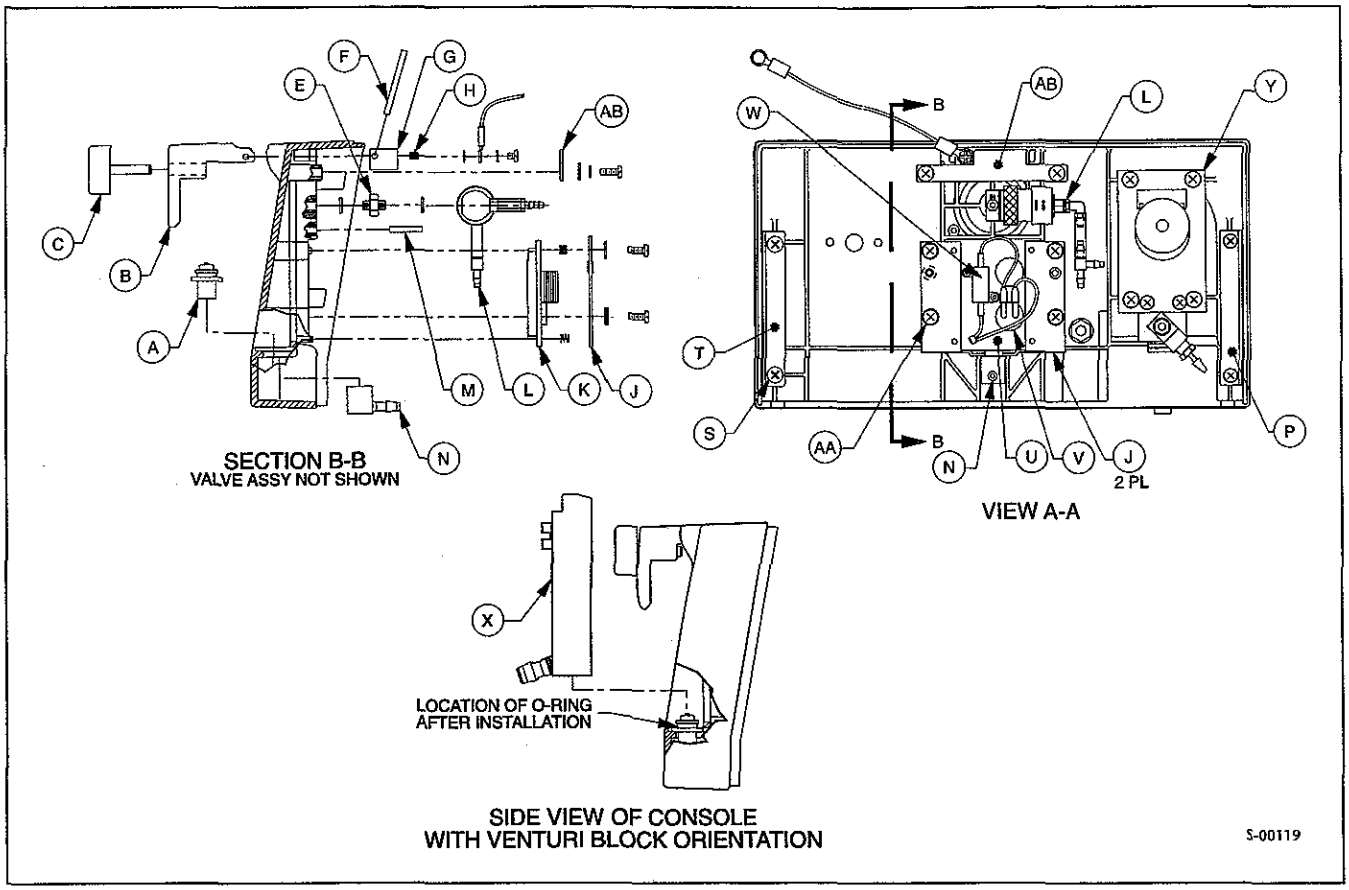

Figure 8-5. Pneumatic Console Assembly

Table 8-5: Pneumatic Console Assembly Parts List

Reference	Description	Part Number
A	Venturi Nozzle Assembly Model 500	N-1150016-SP
	Venturi Nozzle Assembly Model 950 or CE model 500	N-1195016-SP
B	Clamp Assembly, Venturi Block	N-2175013
C	Knob, Clamp, ISV	N-2175038
E	FTG, Short Coupling, #10-32, BRS	N-3600141
F	Dowel Pin, .125 DIA x .750L	N-3400062
G	Pivot Block, ISV	N-2175014
H	Screw, SKTHD, Set 6-32 x 3/16	N-3100511
J	Support, Heater Block	N-2175010
K	Block Assembly, Heater	N-1150019
L	Valve Assembly, PEEP/IMV, SV-10	N-1150021-SP
M	Dowel Pin, .125 dia x 1.50 L, SS	N-3400063
N	FTG, Barb, 90 degree 1/8 NPTF x 3/1	N-3610054

Table 8-5: Pneumatic Console Assembly Parts List (continued)

Reference	Description	Part Number
P	Bracket, Base Support, Right	N-2175023-2
S	Screw, Panhead, Phil, 8-32 x 3/8	N-3100036
T	Bracket, Base Support, Left	N-2175023-1
U	Plate, Heating, ISV	N-2175007
V	Thermistor, open @ 140/close @ 120	N-5500008
W	Resistor, Power, 30 ohms, 10W, 1%	N-6800053
X	Venturi Block Assembly, Threaded	N-1150024-SP
Y	Valve Assembly, Relief	N-1150009-SP
AA	Screw, Phil, Panhead, #6-32 x 3/8	N-3100026
AB	Retainer, Pivot Block ISV	N-2175015

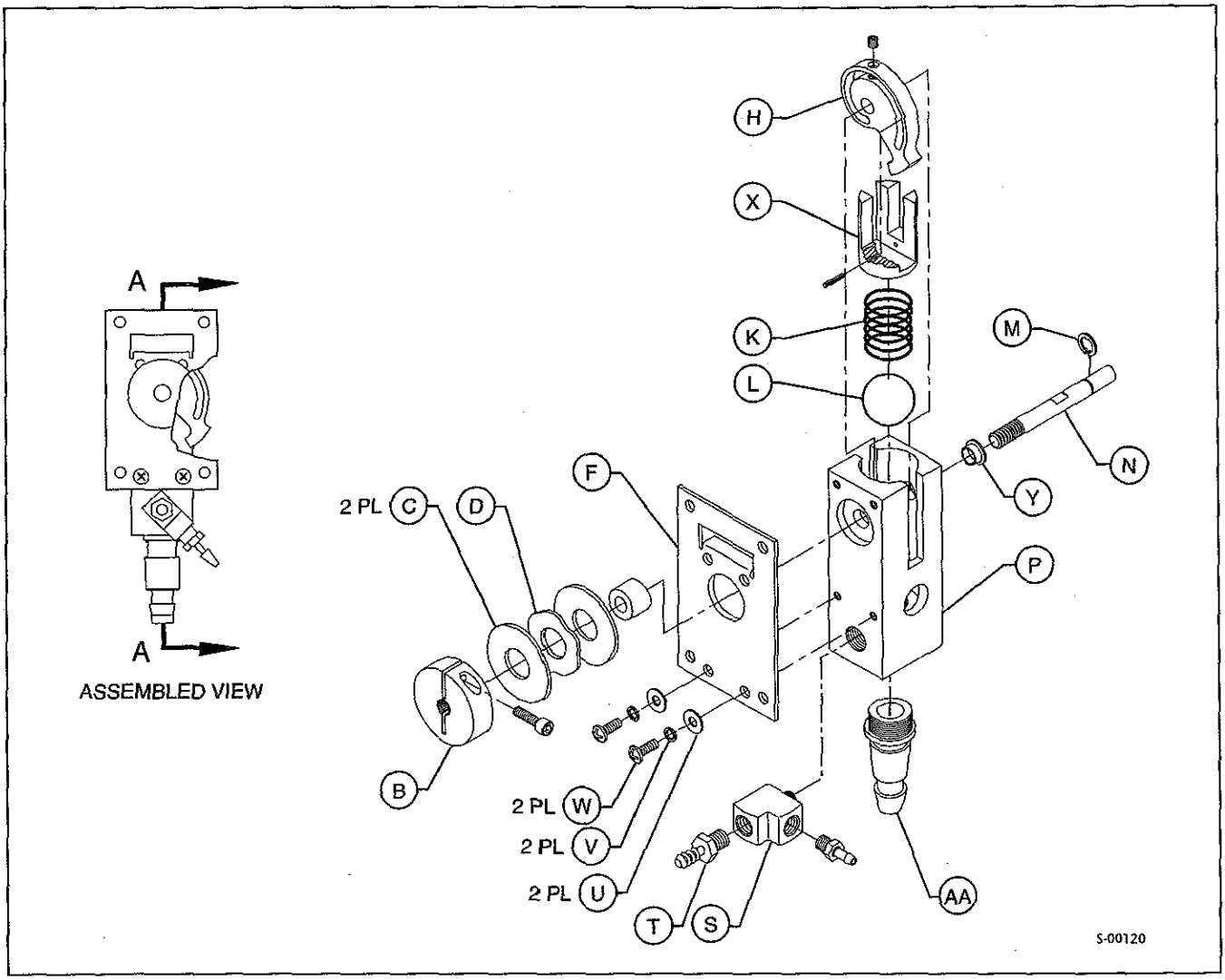

Figure 8-6. Relief Valve Assembly

Table 8-6: Relief Valve Assembly Parts List

Reference	Description	Part Number
B	Collar, Shaft	N-2175052
C	Washer, Nylon, .505 ID x 1.25 OD	N-3220154
D	Washer, Wave, .578 ID x .995 OD	N-3220155
F	Bracket, Relief Valve MTG	N-2175027
H	Cam, Relief Valve, ISV	N-2175031
K	Spring, Relief Valve	N-2175053
L	Ball, 3/4 dia. Delrin	N-4800182
M	Retaining Ring, .25 OD, .219 DX .029 GRV	N-3700045
N	Shaft, Relief Valve	N-2175033
P	Valve Block, Relief	N-2175032
R	Fitting, Barb NYL, 1/8 NPT - 1/8 Hose	N-3610020

Table 8-6: Relief Valve Assembly Parts List (continued)

Reference	Description	Part Number
S	Fitting, Street-T, 1/8 NPT x 1/8 NPTF (2)	N-3600122
U	Washer Flat, #6 .156 ID x .375 OD	N-3220006
V	Washer, Split Lock, #6	N-3220032
W	Screws, Phil Panhead #6-32 x 3/8	N-3100026
X	Plunger, Relief Valve Cam	N-2175030
Y	Bushing, Flanged, .250 x .295 D x .25, NYL	N-4800195
AA	Fitting, 10 and 15 mm Barb	N-2175029

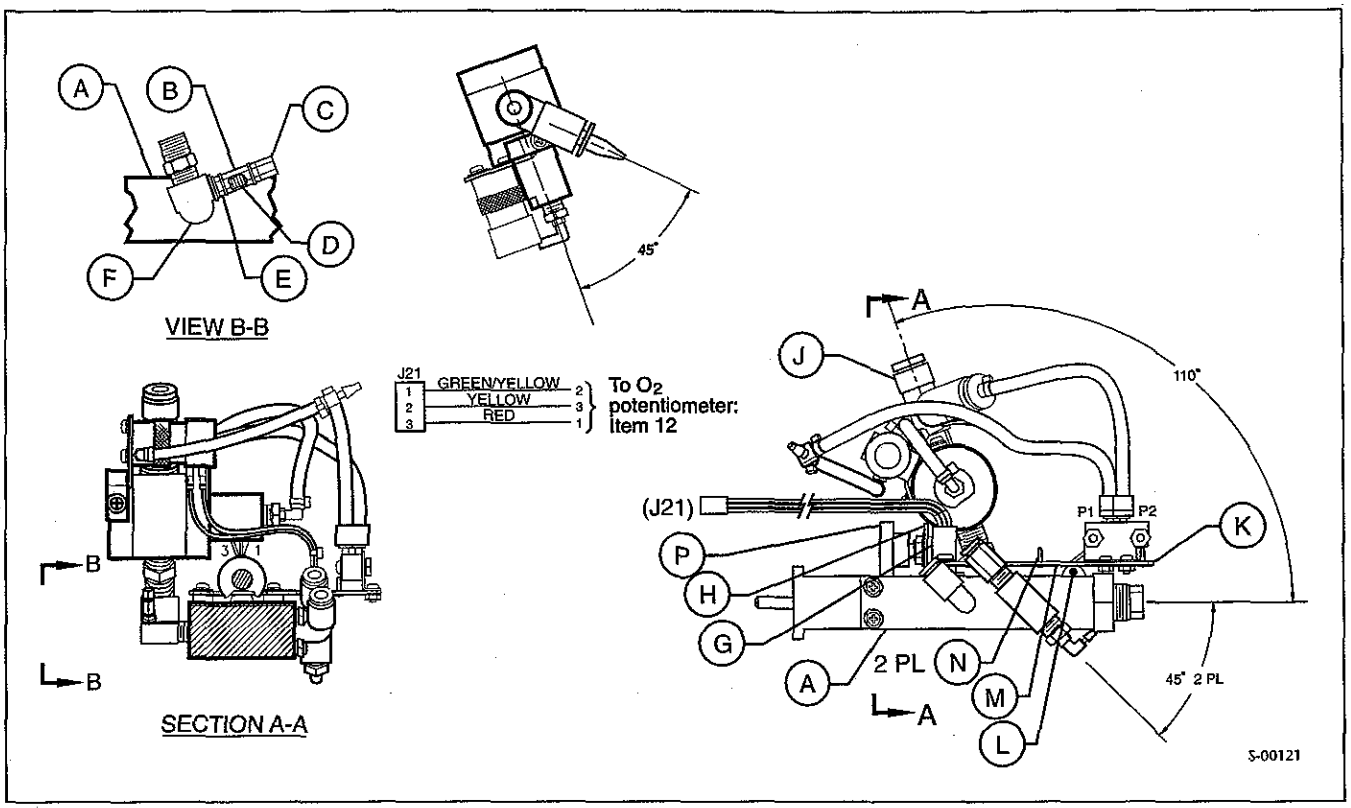

Figure 8-7. O_2 Blender Assembly

Table 8-7: O_2 Blender Assembly Parts List

Reference	Description	Part Number
A	Blender Assembly, O_2, Model 500	N-1220069-SP
B	Housing, Restrictor	N-2101278
C	Fitting, Hoser 10-32 to 1/8 Barb Assembly	N-3600129
D	Restrictor, Jeweled Typer .015"	N-3540015
E	Fitting, Short Coupling, #10-32	N-3600141
F	Fitting O_2 Bleed	N-2101313
G	Pot, Single Turn	N-6300009
H	Bracket, Potentiometer	N-2101221
J	Flow Control Assembly., Blender	N-1101301-SP
K	Differential Pressure PCA	N-1101186-SP
L	Bumper, .44 DIA x .20 High	N-4800042
M	Insulation, Differential	N-2101365
N	Button, Mounting	N-7800024
P	Gear, Sput, Molded	N-4240001

SECTION 9

Alarms and Troubleshooting

9.1 Software Diagnosed Alarms

The ventilator microprocessor can diagnose problems with the functioning of the ventilator. When one of these conditions is identified, the phrase "Ventilator Inoperative" and an error code are seen in the "Selected Data" display window. A list of these error codes, the problem they identify and the probable cause for each appears in Table 9-1, Ventilator Inoperative Alarm Troubleshooting Chart.

Table 9-1: "Ventilator Inoperative" Alarm Troubleshooting Chart

Error Code	Problem	Probable Cause
None	10 V battery fully discharged fuse blown or battery damaged. Accompanied by a POWER LOSS LED. Power Supply or MP2 PCA failures.	10 V battery (if during internal Battery operation) MP2 PCA. Power Supply Assembly.
E01	Unable to perform automatic rezeroing of Proximal Pressure Transducer on power up or after 24 hours of continuous operation.	Pressure Transducer PCA. (May require rezero of Proximal Pressure Transducer.)
E02	Data error (checksum) error found in data from MP101. Two errors detected within 10 msec.	MP101 PCA I/O PCA MP2 PCA
E03	Internal checks	Position 4 of SW1 on MP2 PCA is not in open (off) position or MP2 PCA failures.
E04	Internal checks	MP101 PCA failure
E05	Error found in data sent to MP2 (PIP display shows index number of erroneous data).	MP101 PCA I/O PCA
E06, E07	Control panel potentiometer (Pot) out of range E06 = low, E07 = high PIP shows POT NUMBER **Pot No. Pot Name** 0 Flow Rate 1 Ventilator Rate 2 PEEP/CPAP 3 Inspiratory Time 4 Low Inspiratory Pressure 5 Peak Inspiratory Pressure 6 Not used 7 Not used 8 HFV Rate 9 HFV Amplitude	Control Panel PCA Analog PCA Check J11 cable also look at pins of pot or solder splashes

Table 9-1: "Ventilator Inoperative" Alarm Troubleshooting Chart (continued)

Error Code	Problem	Probable Cause
E08	MP2 waited too long for data from MP101.	MP101 PCA MP2 PCA
E09	Two consecutive A/D errors.	Analog PCA
E10	Exhalation valve (SV 10) closed for longer than 3.5 seconds as indicated by EXHAL (J5X-8) on Alarm/Driver PCA staying low for longer than 3.5 seconds. E10 is also displayed 3.5 seconds after a VENT INOP occurs when no other error code has been previously displayed.	Alarm Driver PCA Power Supply Assembly Various cable assemblies MP101 PCA MP2 PCA I/O PCA
E11	No flow greater than 4 Lpm for 66 seconds indicated by the FLOW signal on Alarm/Driver PCA staying low for more than 66 seconds.	Alarm Driver PCA The PIP was held higher than the set PIP by more than 15 cmH_2O for 66 seconds.
E12	No HFV breath in 4 seconds as indicated by FLOW on Alarm/Driver PCA staying low for longer than 4 seconds in HFV mode.	Alarm Driver PCA The PIP was held higher than the set PIP by more than 15 cmH_2O for 4 seconds during an obstructed tube alarm.
E13	MP2 failed to acknowledge MP101 data transmission.	MP2 PCA
E14	MP101 Startup RAM check error.	MP101 PCA (RAM IC)
E15	MP101 Background RAM check error.	MP101 PCA (RAM IC)
E16	MP101 ROM check error.	MP101 PCA (ROM IC)
E17	Not used	
E18	MP2 Startup RAM check error.	MP2 PCA (RAM IC)
E19	MP2 Background RAM check error.	MP2 PCA (RAM IC)
E20	MP2 Background ROM check error.	MP2 PCA (ROM IC)
E21	MP2 Background ROM check error.	MP2 PCA (ROM IC)
E22	MP2 detects error in its own software interrupt routine.	MP101 PCA
E23	Zero offset of 0 to 100 cmH_2O A/D converter output >5 cmH_2O.	Pressure transducer PCA. (May require rezero of Proximal Pressure transducer.)
E24	Zero offset of 0 to 100 cmH_2O A/D converter output <-5 cmH_2O.	
E25	Zero offset of 0 to -50 cmH_2O A/D converter output >5 cmH_2O	
E26	Zero offset of 0 to -50 cmH_2O A/D converter output <-5 cmH_2O.	
E27	Zero offset of -5 to +50 cmH_2O A/D converter output >5 cmH_2O	
E28	Zero offset of -5 to +50 cmH_2O A/D converter output <-5 cmH_2O	Pressure transducer PCA. (May require rezero of Proximal Pressure transducer.)
E29	Zero offset of METER VOLTS A/D converter output >6 cmH_2O.	
E30	Zero offset of METER VOLTS.	

Table 9-1: "Ventilator Inoperative" Alarm Troubleshooting Chart (continued)

Error Code	Problem	Probable Cause
E31	Internal 3 V battery reference varies greater than 10%.	Power Supply PCA Analog PCA
E32	Front Panel Identification is NOT valid.	Front Panel is incompatible with installed. software or identification is intermittent
E33	Delivery mode is NOT valid.	Ventilator delivery mode is not a valid. selection
E34	Dead Battery.	10.8 V dc Battery Pack is bad.

9.2 Infant Star Troubleshooting Guide

This troubleshooting guide should be used with a Mallinckrodt Circuit P/N – N-501011, and Test Lung P/N – N-1101262.

The *Infant Star Service Manual* has the references for standard test conditions and regular testing equipment. Always check the external parts of the Infant *Star* for a problem before opening it for repair.

The following guides address conditions that may or may not occur with your ventilator. These guides state problems that may be encountered, they list a probable cause(s) for the identified problems, and they give suggestions for troubleshooting and correcting these conditions.

9.2.1 IMV Standard Test

Problem	PIP set to 40 cmH_2O, but only reaches 38.
Possible Causes	1. SV1 not energized or flows from 2 - 4 Lpm are low. 2. I time was set to 0.1 but should be 1.0. 3. Small hole in the diaphragm. 4. Pop-off valve not seating, not screwed fully clockwise. 5. Pop-off valve damaged or debris on ball or seat.
Suggested Actions	1. Check flows; if low, clean restrictor in the proportional manifold. 2. Set I time to 1.0. 3. Replace diaphragm. 4. Turn pop-off valve fully clockwise. 5. Clean or replace ball or seat.
Problem	Display settings drift more than 2 increments.
Suggested Actions	Replace F/P PCA or Analog PCA.
Problem	PIP set to 10 cmH_2O, but reaches 12 or higher.
Probable Causes	1. Diaphragm installed backward. 2. Leak in Flow Manifold - caused by very dirty or broken flow solenoid spider. 3. Film on diaphragm making diaphragm stick or bad diaphragm. 4. Diaphragm seat on venturi block not completely seated.
Suggested Actions	1. Reinstall diaphragm. 2. Clean or replace solenoid. 3. Clean or replace diaphragm. 4. Replace venturi block.
Problem	PIP set to 90 cmH_2O, but only reaches 87.
Possible Causes	1. IMV Regulator out of calibration. 2. Pop-off valve leaking. 3. Circuit on test lung leaking.
Suggested Actions	1. Calibrate IMV Regulator to 60 cmH_2O. 2. Clean, check the adjuster and spring and ball; replace as necessary.

9.2.2 Obstructed Tube Alarms A01 Test, A01, A02, A05

Problem	A01 Alarm 5 cmH_2O over PIP (set by control panel -- HIP)
Possible Causes	1. Too short a circuit, and/or Proximal line. 2. Possible leaky flow solenoid. 3. SVO not closing.
Suggested Actions	1. Locate a proper circuit and test lung. 2. Clean flow solenoids; check for broken spiders. Replace if necessary. If the problem still exists test for leaky solenoid: Turn off the ventilator. Connect air and oxygen. Plug SV7 safety vent valve hole (black, threaded cylinder under flow manifold facing toward outside of ventilator). Connect tube from To Patient port into cup of water. Bubbles indicate a leak coming from flow manifold. Clean or replace solenoids as necessary. 3. Check electrical connection.
Problem	A05 Alarm 10 cmH_2O over PIP
Possible Causes	1. Blocked inspiratory tube on patient circuit or To Patient port is plugged. 2. Water in Proximal line or in proximal accumulator inside ventilator. 3. Needle valve out of calibration. 4. Large leak in flow solenoid valve.
Suggested Actions	1. Clear blockage. 2. Disconnect tubing on both sides of accumulator and blow out with an air nozzle. Install proximal line filter P/N – N-4403017 water from entering ventilator. 3. Calibrate needle valve. 4. Check flow valves for broken spider.
Problem	No A05 Alarm
Probable Causes	Faulty Transducer PCA
Suggested Actions	To test A05 Alarm: plug patient port. Replace Transducer PCA.

9.2.3 PEEP 0 to 24 cmH_2O

Check PEEP calibration before continuing. If necessary, clean SV8.

Problem	PEEP set to 5 cmH_2O but reaches 6 or higher
Possible Causes	1. PEEP calibration may be incorrect. 2. PEEP regulator cracking pressure too high. 3. Diaphragm installed backwards. 4. Low jet venturi operation.
Suggested Actions	1. Check or calibrate PEEP/CPAP needle valve adjustment. 2a. Inspect 0.024 restrictor (downstream from SV8), clean if necessary. 2b. Check R7 setting. 3. Reinstall diaphragm or replace diaphragm. 4a. Check or calibrate venturi needle valve adjustment, if installed. 4b. Check R7 setting.
Problem	PEEP set to 5 cmH_2O but only reaches 4 or less
Possible Causes	1. Diaphragm not seated properly. 2. Damaged jet venturi O-ring. 3. Cap on PEEP regulator loose, cracked, or broken.
Suggested Actions	1a. Check or calibrate PEEP/CPAP needle valve adjustment. 1b. Reseat diaphragm. 2a. Check O-ring between jet and venturi body. 2b. Inspect venturi body for damage. 3. Tighten regulator cap, if required or replace PEEP regulator (R6).

9.2.4 PEEP Circuit

Problem	Cannot calibrate a PEEP of 20 cmH_2O (Without any pressure from the PEEP circuit, a setting of 20 to 24 cmH_2O will result in a 13 to 15 cmH_2O PEEP.)
Possible Causes	1. Leak in internal PEEP circuit 2. SV8 not energizing. 3. No air flow through SV8. 4. Pop-off valve not fully closed. 5. Faulty internal PEEP circuit. 6. Faulty needle valve. 7. Faulty SV8. 8. Flow does not reach 8 Lpm.
Suggested Actions	1. Check all tube connections. 2. Check electrical connections. **Caution** Do not break the needle valve. Disconnect SV8 tubing only. Do not pull off needle valve. 3. Pull needle valve off SV8 and listen for air pulses. 4. Turn fully clockwise. 5. Check circuit for broken white elbow. 6. Clean or replace needle valve. 7. Clean or replace SV8. 8. Correct flow setting.

9.2.5 Venturi Solenoid (SV9)

Controls the baseline pressure when the PEEP circuit is not in use. Venturi and PEEP never operate at the same time.

NOTE:

See venturi calibration for newer Infant *Star* models 500 and 950.

Problem	A04 Alarm
Possible Causes	1. Jet Venturi nozzle plugged. 2. Pressure going to back of diaphragm.
Suggested Actions	1. Clean nozzle. Using an eyeloop, check nozzle's orifice for a crack; replace if necessary. 2a. First, disconnect tube behind diaphragm, if problem corrects reconnect tube. 2b. Second, disconnect the PEEP regulator output, if problem corrects check PEEP circuit. 2c. Third, disconnect the IMV regulator output, if problem corrects check SV10 IMV select valve.
Problem	Unstable baseline
Possible Causes	1. Dirty SV9 2. Faulty SV9 3. Inlet pressures are 50 psi or higher.
Suggested Actions	1. Clean SV9. 2. Replace SV9. 3. Check static or 45 psi or above dynamic.